Modeling in solid mechanics

Academic Year: (2019 / 2020) **Review date: 20-04-2017**

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

Coordinating teacher: ZAHR VIÑUELA, JORGE ALONSO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

-- Mechanics of Structures
-- Elasticity and Strength of Materials

OBJECTIVES

The student will learn the background needed to analyse structural engineering problems with finite element codes, when the material is linear elastic in static or quiasi-static cases.

These knowledge will be applied to the modelization of structural elements of industrial interest, identifying the parameters defining the problem and developing a critical analysis of the results.

In a second stage, the student will be introduced to the mechanical behavior of materials exhibiting elastic-plastic deformation: the concept of plastic strain will be studied and methods for assessing structural problems involving these kind of materials will be described. Also, it will be described how the Finite Element Method has to be formulated in order to be applied to structural problems involving non-linear elastic-plastic materials.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- Introduction to the Finite Element Method and its aplications in Linear Elasticity
- Main concepts. Rayleigh Ritz method. Finite Element Method.
- Firsts applications: FEM for truss-structures and beam-structures.
- Finite elements for 2D-elasticity: triangle and quadrilateral element types.
- Numerical integration in the FEM
- Pre-processing and modeling techniques: element selection, mesh method, use of symmetries, boundary conditions.
- Post-processing and analysis of results.

2.- Introduction to Elastic-Plastic material behavior
- Phenomenological aspects of plastic strain.
- Limit state: the concepts of "yield function" and "yield surface".
- Stress-strain relations in Plasticity: "Total" and "Incremental" plasticity models.
- Finite Element Method in Plasticity: formulation and simple applications.

ASSESSMENT SYSTEM

The evaluation of the course is in two parts: on the one hand, there will be a Final Exam involving the solution of practical problems and, possibly, a number of theoretical inquires. On the other hand, a system for Continued Evaluation will be implemented, based on the presentation of reports and participation in the classroom.

Final Exam (mandatory): 40%
Continued evaluation: 60%

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

BASIC BIBLIOGRAPHY

- Fish & Belytschko A First Course in Finite Elements, John Wiley & Sons, 2007

- Ottosen & Ristinmaa The mechanics of Constitutive Modeling, Elsevier, 2005

- Sánchez Gálvez, Vicente Curso de comportamiento plástico de los materiales, Universidad Politécnica de Madrid, Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos, Departamento de Ciencia de Materiales., 1999

- Zienkiewicz & Taylor El Metodo De Elementos Finitos español, Vol 1 y 2, CIMNE, 2004