Numerical modelling of structural elements

Academic Year: (2024 / 2025) **Review date: 24-01-2025**

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

Coordinating teacher: GOMEZ SILVA, FRANCISCO

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

-Mechanics of Structures
-Elasticity and Strength of Materials

SKILLS AND LEARNING OUTCOMES

RA1.2: An systematic understanding of the key aspects and concepts of their branch of engineering.
RA1.3: Coherent knowledge of their branch of engineering including some at the forefront of the branch.
RA2.1: The ability to apply their knowledge and understanding to identify, formulate and solve engineering problems using established methods.
RA2.3: The ability to select and apply relevant analytic and modelling methods.
RA3.2: An understanding of design methodologies, and an ability to use them.
RA4.2: Rhe ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
RA5.2: The ability to combine theory and practice to solve engineering problems.
RA5.3: An understanding of applicable techniques and methods, and of their limitations.
RA5.4: An awareness of the non-technical implications of engineering practice.
RA6.3: Demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice.
CB1: Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2: Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1: Ability to resolve problems with initiative, creativity decision-making and critical reasoning skills, and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering area.
CG3: Capacity to design a system, component or process in the area of mechanical engineering in compliance with required specifications.
CG9: Knowledge and capacity to apply computational and experimental tools for analysis and quantification of mechanical engineering problems.
CE5: Knowledge and capacity to construct and design industrial structures and buildings.

OBJECTIVES

By the end of this subject, students will be able to have:

1. a systematic understanding of the key aspects and concepts for the modeling structures with the finite element method.
2. the ability to apply their knowledge and understanding to identify, formulate and solve problems of structural mechanics using the finite element method;
3. the ability to select and apply the finite element method to structural mechanics problems.
4. an understanding of methodologies in finite element simulation to the design of structures and industrial constructions.

5. the ability to combine theory and practice of the finite element method to solve problems in the field of structural mechanics.
6. an understanding of applicable techniques and methods in finite element modeling, and of their limitations;

DESCRIPTION OF CONTENTS: PROGRAMME

- Fundamental concepts. Rayleigh-Ritz method. Finite Element method.
- Application to structures: truss and beam finite elements.
- Application to two- and three-dimensional problems: triangle, quadrilateral and brick finite elements.
- Pre-processing and modeling techniques: selection of the element, meshing, symmetries, boundary conditions.
- Post-processing and analysis of results.

LEARNING ACTIVITIES AND METHODOLOGY

-- 50% of theory lessons: learn the methodologies to solve mechanical problems with the Finite Element Method.
-- 50% of computer lessons: develop programming codes to solve mechanical problems with the Finite Element Method.

-- Tutorials and personal work of the student, oriented to the acquisition of practical skills related to the program of the subject.

ASSESSMENT SYSTEM

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

1. CONTINUOUS ASSESSMENT:
A continuous assessment will be developed based on a number of practical group works, from which the students will have to hand in the developed codes. 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 practice note in the continuous evaluation corresponds to the established in the course, in accordance with the university regulations. In the course Strength of Materials, the weighting of the laboratory practices takes the value of 60% of the final mark.

2. FINAL GRADE OF THE COURSE:
A final exam will be taken with a weight of 40% on the final grade.

BASIC BIBLIOGRAPHY

- P.M. Kurowski Finite Element Analysis For Design Engineers, SAE International, 2004

- T.R. Chandrupatla, A.D. Belegundu Introduction to Finite elements in Engineering, Prentice Hall, 1991

ADDITIONAL BIBLIOGRAPHY

- S. S. Quek, G.R. Liu The Finite Element Method: A Practical Course, Butterworth-Heinemann, 2003