Numerical modelling of structural elements

Academic Year: (2023 / 2024) **Review date: 28-03-2023**

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

Coordinating teacher: ZAERA POLO, RAMON EULALIO

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

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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.
RA6. Transversal Skills: To have the necessary skills for the practice of engineering in today's society.

OBJECTIVES

Upon successful completion of this course, students will be able to:

1. Know and understand the scientific and mathematical principles underlying the Finite Element method.
2. Choose and apply modeling methods to the calculation of structures.
3. Understand the different methods and be able to use them, and know their limitations.
4. Work effectively both individually and as part of a team.

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

-- Continuous Evaluation based on a number of deliverable programming codes of practical works done by groups. The average qualification obtained amounts for 50% of the final qualification of the course.

-- Final exam at the end of the semester. It amounts for 50% of the final qualification of the course.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

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

- E. Oñate Cálculo de Estructuras por el Método de los Elementos Finitos. Análisis Estático Lineal, CIMNE, 1995
- O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu El Método de los Elementos Finitos. Vol 1, Las Bases, CIMNE, 2010
- S. S. Quek, G.R. Liu The Finite Element Method: A Practical Course, Butterworth-Heinemann, 2003