Mechanics of Structures

Academic Year: (2023 / 2024) **Review date: 12-02-2024**

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

Coordinating teacher: ARIAS HERNANDEZ, ANGEL

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

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.
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.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
CG10. Ability to design and carry out experiments and to analyse and interpret the data obtained.
CG19. Knowledge and use of the principles of strength of materials.

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
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
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.

OBJECTIVES

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

1. Knowledge and understanding: Having basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as a knowledge of the Mechanics of Solids and Structures.

2. Engineering Analysis: Being able to identify engineering problems within the industrial field, recognize specifications, establish different resolution methods and select the most appropriate for their solution.

3. Research and Innovation: Being able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.

4. Engineering Applications: Being able to apply their knowledge and understanding to solve problems, and design devices or processes in the field of industrial engineering according to criteria of cost, quality, safety, efficiency and respect for the environment.

5. knowledge and understanding of strength of materials and structural calculus.
6. awareness of the wider multidisciplinary context of engineering.
7. the ability to apply their knowledge and understanding to identify, formulate and solve problems of strength of materials and structural calculus

using established methods;
8. the ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
9. workshop and laboratory skills.
10. the ability to select and use appropriate equipment, tools and methods;
11. the ability to combine theory and practice to solve problems of strength of materials and structural calculus
12. an understanding of applicable techniques and methods in mechanics of structures, and their limitations;

DESCRIPTION OF CONTENTS: PROGRAMME

I: BEHAVIOUR OF REAL BODY EQUILIBRIUM AND CALCULUS OF REACTIONS FOR STRUCTURAL MECHANICS
Topic 1: FORCE SYSTEMS AND EQUILIBRIUM
1.1 Main concepts
1.2 Force systems and equivalent force systems
Topic 2: REACTIONS FORCES
2.1 Computation of reactions in statically determinate structures
2.2 Computation of reactions in statically indeterminate externally structures
Topic 3: MASS GEOMETRY
3.1 Centre of mass of planar bodies
3.2 Moment of inertia of planar bodies

II: FORCE LAWS IN ISOSTATIC STRUCTURES
Topic 4: FORCE LAWS (I)
4.1 Concept and types of internal forces
4.2 Relationship between load, shear force and bending moment
Topic 5: FORCE LAWS (II)
5.1 Determination of internal forces in simple beams
5.2 Determination of internal forces in archs
Topic 6: FORCE LAWS (III)
6.1 Determination of internal forces for complex beams
6.2 Determination of internal forces for frames
III: TRUSS STRUCTURES AND CABLE STRUCTURES
Topic 7: TRUSSES
7.1 Internal forces for trusses
7.2 Resolution procedures
Topic 8: CABLES
8.1 Cables under concentrated loads
8.2 Cables under distributed loads
IV: CONCEPT OF UNIAXIAL STRESS AND UNIAXIAL STRAIN
RELATIONSHIP BETWEEN STRESS AND STRAIN IN ELASTIC SOLIDS
Topic 9: DEFORMABLE BODY
9.1 Main concepts. Cauchy stress
9.2 Mechanical behaviour of solids
V: PRINCIPLES OF STRENGHT OF MATERIALS. GENERAL STUDY OF STRUCTURAL BEHAVIOUR OF SECTION STRENGTH
Topic 10: TENSILE/COMPRESSION (I)
10.1 Principles of strenght of materials
10.2 Tensile and compressive axial force
Topic 11: BENDING (II)
11.1 Strength of materials. Bending (I)
11.2 Pure bending
Topic 12: BENDING (III)
12.1 Strength of materials. Bending (II)
12.2 Complex bending
VI: INTRODUCTION TO EXPERIMENTAL METHODS FOR STRUCTURAL MECHANICS ENGINEERING APPLICATIONS
4 Laboratory sessions

LEARNING ACTIVITIES AND METHODOLOGY

- Master class, sessions of questions resolution in reduced groups, students presentations, individual sessions, and personal student work for theoretical knowledge (3 ECTS).

- Practical sessions of laboratory and sessions of problems in reduced groups, individual sessions, and

personal student work for practical knowledge (3 ECTS).

Additionally, collective tutorship can be included in the programme.

ASSESSMENT SYSTEM

Continuum assessment system based on short tests and laboratory reports.
Master class, sessions of questions resolution in reduced groups, students presentations, individual sessions, and personal student work for theoretical knowledge.
Practical sessions of laboratory and sessions of problems in reduced groups, individual sessions, and personal student work for practical knowledge.

A minimum grade of 4.5 in the final exam is required to take into account the continuum assessment.

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 this subject, the weighting of the laboratory practices takes the value of 37.5% of the continuous assessment grade.

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

BASIC BIBLIOGRAPHY

- F.P. Beer, E. Russel Johnston Vector Mechanics for Engineers., Vol. Static, McGraw Hill, 1994
- J. Case Strength of material and structures, Arnold, 1999
- J.M. Gere Mechanics of materials, Ed. Thomson, 2002
- W.M.C. McKenzie Examples in structural analysis, Taylor & Francis, 2006