# Aerospace Structures

**Academic Year: ( 2022 / 2023 )** **Review date: 02-09-2022**

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

**Coordinating teacher: ARTERO GUERRERO, JOSE ALFONSO**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 3 Semester : 1**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

We strongly advise you not to take this course if you have not passed Physics I , Introduction to Mechanics of Flight and Introduction to structural analysis.

## OBJECTIVES

Knowledge of the basic tools for the calculation of thin-walled beams, that provide to the student the ability to design structural components of the aerospace industry.
Acquisition of the technological knowledge needed to calculate bidimensional structural elements used in aerospace structures.
Knowledge of the basics of the design of structures made of composite materials, including composite laminates and sandwich structures, which are widely used in aerospace industry.
Familiarity with the fundamentals of the design of the main structural elements and systems used in aircrafts.
Ability to use specific software to analyse, design and calculation of structural elements, developing a critical awareness.

## DESCRIPTION OF CONTENTS: PROGRAMME

Chapter 1. Structures in the aerospace and aeronautical sector
Subject 1. Structural description of the aircraft
- 1.1 Loads on aircraft structures
- 1.2 Function of structural components
- 1.3 Wing structure
- 1.4 Fuselage structure
- 1.5 Stabilizers structure
- 1.6 Helicopter structure

Subject 2. Structures in the aeronautical sector
- 2.1 Frame and truss structures
- 2.2 Space structures
- 2.3. Future trends

2.4. Energetic methods
2.5. Thermal loads

Chapter 2. Bending, shear and torsion of thin-walled beams
Subject 3 and 4. Bending and shear of open and closed, thin-walled beams
- 3.1 Kinematic hypothesis
- 3.2 Shear of open section beams
- 3.3 Shear of closed section beams
- 3.4 Shear centre

Subject 5. Torsion of beams
- 5.1 Torsion of closed section beams
- 5.2 Torsion of open section beams

Subject 6. Torsion on multiple-cell thin-walled beams
- 6.1 Torsion of multiple-cell closed section beams
- 6.2 Torsion of multiple-cell open section beams

Chapter 3. Plates and Shells
Subject 7 and 8. Bending of thin plates
- 7. 1 Kinematic
- 7.2 Plates subjected to a distributed transverse loads
- 7.3 Plates subjected to bending and twisting

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Subject 9 and 10. Shells
- 9.1 Hypotheses
  9.2 Thin shells subjected to in-plane loads
  9.3 Thin shells subjected to bending loads

Chapter 4. Laminate and sandwich structures
Subject 11. Theory of laminate
- 11.1 Kinematic
- 11.2 Orthotropic constitutive equations
- 11.3 Classical and first-order theories of laminate composites
- 11.4 Failure criteria

Subject 12. Composite beams and plates
- 12.1 Composite beams subjected to bending
- 12.2 Composite thin-walled cross-section beams
- 12.3 Bending of composite plates

Subject 13. Sandwich structures
- 13.1 Basic sandwich theory
- 13.2 Sandwich beams
- 13.3 Sandwich plates

## LEARNING ACTIVITIES AND METHODOLOGY

In each week one lecture session ONLINE (master class) and one practical session (in reduced groups) will be taught. The first is geared to the acquisition of theoretical knowledge, and the second to the acquisition of practical skills related to theoretical concepts. Additionally, students will complement the classes with work at home, using material provided on Aula Global.

In addition to these sessions, four laboratory practical sessions in reduced groups (maximum 20 students) will be impart. These practices are mandatory.

Students also have the possibility of individual tutorials.

## ASSESSMENT SYSTEM

Final exam (mandatory): 60%
Continuum assessment: 40%
- Laboratory report: 15%
- Evaluation tests: 15%
- Topic report: 10%

If the mark obtained in the final exam is lower than 4.5, the final mark of the student will be computed only with the final exam.

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 laboratorypractice 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 Aerospace structures, the weighting of the laboratory practices takes the value of 37,5%(*) of the continuous assessment grade.

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

## BASIC BIBLIOGRAPHY


- Barbero E.J. Introduction to composite materials, Taylor and Francis, 1999
- Megson, T.H.G. Aircraft structures for engineering students, Elsevier, 2007
- Timoshenko, S.P. Theory of plates and shells, McGraw Hill, 1st ed. 1940


## ADDITIONAL BIBLIOGRAPHY


- Daniels I.M. , Isahi Engineering Mechanics of composite materials, Oxford Univerisyty Press, 1994
- Ugural, A. C. Stresses in beams, plates, and shells, Taylor & Francis, 2009
- Vinson, J. R. The Behavior of thin walled structures: beams, plates, and shells, Kluwer Academic Publishers, 1989