1. BASIC INFORMATION

Course	Aeronautical Structures
Degree program	Degree in Aerospace Engineering (Aircraft)
School	School of Arquitecture, Engineering and Design
Year	Third
ECTS	6 ECTS
Credit type	Degree Requirements
Language(s)	English
Delivery mode	Face to face
Semester	First Semester
Academic year	2024/2025
Coordinating professor	Almudena Vega

2. PRESENTATION

The subject "Aeronautical Structures" is a required subject within the curriculum of the Degree in Aerospace Engineering at the European University of Madrid. This subject is included in one of the traditional guiding vectors in the training process of the future graduate in Aerospace Engineering who acquires a solid knowledge in Structures, necessary for being one of the main areas in which an aircraft is traditionally divided (Airframe, Engines and Systems). As its starting point is the subject Elasticity and Strength of Materials, it is recommended to remember all the concepts of it before taking this subject.

The analysis of aeronautical structures is one of the technical skills that many aeronautical companies look for in their professionals. The skills learned are directly related to the daily work of the aeronautical design department. To understand and analyze structural problems, the student will receive the necessary tools and methodologies.

The subject belongs to the subject "AEROSPACE VEHICLES II"

3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- CB5: Students have developed those learning skills that allow them to proceed with further studies with a large degree of autonomy

Cross-curricular competencies:

- CT14. To solve problems with initiative, decision making, creativity and critical reasoning in a professional way, and the preparation and defense of arguments (problem solving)
- CT18. Commitment with the accomplishment of the assigned tasks (Responsibility)

Specific competencies:

- CE20. Adequate and practical knowledge of the fracture mechanics applied to Fracture Mechanics of the Continuum Media, and Dynamic applications, structural stability and aeroelasticity.
- CE26. Applied knowledge of aerodynamics, Mechanics, Thermodynamics, Flight Mechanics, Aircraft Engineering (fixed and rotatory wing), structures theory.

Learning outcomes:

- RA1. To stablish models as input data to FEA and CFD
- RA2. To carry out studies integrating technologies and engineering procedures developed within this module competences
- RA3. From a series of requirements and prior information, conceptualize an engineering problem, propose an approach to solve it and get a better solution. All this within the competences of this module that could be summarized in the ability to understand and visualize the load paths, idealizing the structure/component and calculating internal loads, stability, failure assessment for various types of structures manually, and understand the practical application of characterization tests from materials to structural engineerin

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CE20, CE26	RA1
CT18, CE26	RA2
CB5, CT14, CE20, CE26	RA3

4. CONTENT

The subject is organized in six learning units, which they are itself subdivided in topics.

1. Introduction to Solid Mechanics and Structures
    - 1.1 Context
    - 1.2 Failure modes and criteria. Strength failure. Mohr Circle
    - 1.3 Loads and safety factors
    - 1.4 Column Stability
2. Beams and frames under Bending and Torsion.
    - 2.1 Main equations. Stresses and Displacements
    - 2.2 Energy Methods: Theorems of Castigliano and Unit Load
    - 2.3 Hyperstaticity
    - 2.4 Archs
    - 2.5 Shear stress distribution in sections. Fabricated beams

3. Truss Structures
    - 3.1 Sections and Joints method
    - 3.2 Hyperstatic structures and displacements
4. Thin Wall Structures
    - 4.1 Principles, loads, description and mission of structural elements
    - 4.2 Bending of open and closed section beams
    - 4.3 Shear of open and closed section beams. Shear center
    - 4.4 Torsion of open and closed section beams
    - 4.5 Structural idealization
    - 4.6 Analysis of combined open and closed sections
    - 4.7 Deformation and Displacement analysis
    - 4.8 Effect of taper in wings
    - 4.9 Fuselage, wings, frames, and ribs analysis.
5. Introduction to analysis of details, vibrations and Composite structures analysis
    - 5.1 Mechanical joints
    - 5.2 Unstability problems in thin wall sections. Crippling and Diagonal tension
    - 5.3 Introduction to vibrations
    - 5.4 Solid laminates and sándwich structure

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Lectures.
- • Class problems, discussed and solved. Cooperation work
- • Assignments (exercises as homework)
- • Project based learning
- • Mentoring, academical assessment.

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Campus-based mode:

Learning activity	Number of hours
Lectures	60 h
Group activities	15 h
Assignments	25 h
Mentoring, tests, and assesments	20 h
Personal study	30 h

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Campus-based mode:

Assessment system	Weight
Exams, tests, and other knowledge assessments	50%
Articles, and Reports. Exercises and problem solving	30%
Alternative evaluation methods. Attention and participation in class solved problems. Group projects, etc	10%
Transversal Competences. Performance observation	10%

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

7.1. First exam period

To pass the subject in the first exam period call you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the subject, and an attendance of more than 50%, unless agreed with the teacher.
In any case, you will need to obtain a grade greater than or equal to 5.0 on exams, tests, and knowledge tests.
When the minimums required to carry out the weighted average of the evaluable activities are not met (the minimum is not reached in any of the previous points), the final grade will be:

- the weighted average if its value is less than or equal to 4
- 4 if the value of the weighted average is greater than 4

The mark in the call will be considered as NP (Not Presented) when the student has not delivered any evaluable activity of which they are part of the weighted average

7.2. Second exam period

To pass the subject in second period you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the subject.
In any case, it will be necessary for you to obtain a grade greater than or equal to 5.0 in the exams, tests, and knowledge tests
Activities not passed in ordinary call, or those that were not delivered must be delivered.
When the minimums required to carry out the weighted average of the evaluable activities are not met (the minimum is not reached in any of the previous points), the final grade will be:

- the weighted average if its value is less than or equal to 4
- 4 if the value of the weighted average is greater than 4

The note in second period exam will be considered as NP (Not Presented) when the student has not submitted any new activity with respect to what is presented in the ordinary call

8. SCHEDULE

This is a tentative planning for the main activities of the subject. Basically every 2 weeks there will be a home assignment that will be due in a given time.

Assessable activities	Deadline

1. Introduction to Solid Mechanics and Structures	1 week
2. Beams and frames under Bending and Torsion	3 weeks
3. Truss Structures	1 week
Exam part 1 (units 1 to 3)	
4. Thin Wall Structures	6 weeks
Exam part 2 (units 4)	
Final Exam	

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

The main reference work for this subject is:

- Megson, Aircraft Structures for Engineering Students

In addition to that there will be access to

- Class notes
- Guidelines
- Exercises solutions
- Virtual campus contents

Another recommended bibliography is:

- Bruhn, Analysis and Design of Flight vehicle structures
- Niu, Airframe structural design
- Niu, Airframe stress analysis and sizing
- Roark,Roark´s formulas for stress and strain
- Niu, Composite Airframe Structures
- Shigley. Mechanical Engineering Design

10. DIVERSITY MANAGEMENT UNIT

Students with specific learning support needs:

Curricular adaptations and adjustments for students with specific learning support needs, in order to guarantee equal opportunities, will be overseen by the Diversity Management Unit (UAD: Unidad de Atención a la Diversidad).

It is compulsory for this Unit to issue a curricular adaptation/adjustment report, and therefore students with specific learning support needs should contact the Unit at unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.