1. BASIC DATA

Subject	Aeronautical Structures
Degree	Degree in Aerospace Engineering (Aircraft)
School/Faculty	School of Arquitecture, Engineering and Design
Course	Third
ECTS	6 ECTS
Type	Degree Requirements
Language	English
Mode	Face to face
Semester	First Semester
Academic Course	2020/2021
Teacher Coordinator	Rafael Pax

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"

- Flight Mechanics 6 ECTS (Third year)
- Aerodynamics and Aeroelasticity 6 ECTS (Third year)
- Space Vehicles and Missiles 6 ECTS (Third course)
- Aircraft Design 6 ECTS (Fourth year)
- Maintenance and Certification of Aerospace Vehicles 6 ECTS (third course)

3. COMPETENCES AND LEARNING OUTCOMES

Core Competences:

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

Cross Curricular Competences:

- 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 Competences:

- 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 engineering.

In the following table, it is provided the relationship between competences developed in the subject and the learning skills that are sought

Competences	Learning Outcomes
CE20, CE26	RA1
CT18, CE26	RA2
CB5, CT14, CE20, CE26	RA3

4. CONTENTS

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

1. Introduction to Solid Mechanics and Structures Introducción a la mecánica de sólidos y estructuras

- 1.1 Context
- 1.2 Failure modes and criterio. Strenght failure
- 1.3 Loads and safety factors
- 1.4 Column Stability
- 1.5 Energy Methods: Theorems of Castigliano and Unit Load
- 1.6 Hyperstaticity

2. Beams and frames under Bending and Torsion.

3. Truss Structures

4. Thin Wall Structures

- 4.1 Princples, loads, description and misión of structural elements
- 4.2 Bending Torsion and Shear of box structures of closed and open section.
- 4.3 Structural effects and consequences in the analysis
- 4.4 Deformation and Displacementn analysis
- 4.4 Effect of taper in wings

- 4.5 Fuselage, wings, frames, and ribs analysis.

5. Introduction to detail analysis and vibrations

- 5.1 Introduction to mechanical joints
- 5.2 Unstability problems in thin wall sections. Crippling and Diagonal tension
- 5.3 Introduction to vibrations

6. Introduction to Composite Structures Analysis.

- **6.1** Solid laminates and sándwich structures

5. TEACHING-LEARNING METHODOLOGIES

Teaching-learning methodologies-are as following:

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

6. EDUCATIONAL ACTIVITIES

As a reference, the type of training activities and student dedication time for each of them is provided:

Modalidad presencial:

Type of educational activity	Number of hours
Lectures	20 h
Group activities	60 h
Assignments	50 h
Mentoring, tests, and assesments	20 h
TOTAL	**150 h**

7. MONITORING and ASSESSMENTS

Assessments systems and percentage in the final mark is given:

Assessable Activity	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 activities you have to complete, as well as the deadline and assessment procedure for each one.

7.1. First exam period

To pass the subject in the nfirst 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 p 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. PLANNING

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.:

Activity	Period
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 I (units 1 to 3)	
4. Thin Wall Structures	6 weeks
5. Introduction to analysis of details and Vibrations	2 week
6. Introduction to Composite (solid laminate and Sandwich) Structures Analysis	1 week
Exam part 2 (units 4 to 6)	
Global subject revisit	1 week
Final Exam	

This planning may suffer modifications from logistics reasons of the activities. Each modification will be properly announced to the students.

9. BIBLIOGRAPHY

The main reference book for this subjects 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 ATTENTION UNIT

Students with specific educational support needs:

Adaptations or curricular adjustments for students with specific educational support needs, in order to guarantee equal opportunities, will be set by the Diversity Attention Unit (UAD).

The issuance of a report of curricular adaptations / adjustments by this Unit will be an essential requirement, so students with specific needs for educational support should contact through: unidad.diversidad@universidadeuropea.es at the beginning of each semester.

HOW TO COMMUNICATE WITH YOUR TEACHER

When you have a question about the contents or activities, do not forget to write it in the forums of your subject so that all your classmates can read it.

It is possible that someone has your same doubt!

If you have any questions exclusively addressed to the teacher, you can send them a private message from the Virtual Campus. Also, in case you need to delve into a topic, you can agree on a tutorial.

It is advisable that you regularly read the messages sent by students and teachers, as they constitute one more way of learning