



## IDENTIFYING DATA

### Solid mechanics and aerospace structures

Subject	Solid mechanics and aerospace structures			
Code	007G410V01921			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Comesaña Piñeiro, Rafael Conde Carnero, Borja			
Lecturers	Bendaña Jácome, Ricardo Javier Comesaña Piñeiro, Rafael Conde Carnero, Borja			
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General description	Introduction to the mechanics of solids and aeronautical structures			

## Training and Learning Results

Code			
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study		
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues		
C20	Appropriate knowledge applied to engineering: mechanics of fracture of the continuous media and their dynamic behavior, fatigue of structural instability and aeroelasticity.		
C26	Applied knowledge of aerodynamics; mechanics and thermodynamics, flight mechanics, aircraft engineering (fixed and rotary wings), theory of structures.		
C33	Applied knowledge of aerodynamics, flight mechanics, air defense engineering (ballistics, missiles and air systems), space propulsion, material science and technology, structure theory.		
D3	Capability of oral and written communication in native language		
D4	Capability of autonomous learning and information management		
D5	Capability to solve problems and draw decisions		
D6	Capability for interpersonal communication		
D8	Capability for critical and self-critical reasoning		
D11	Show motivation for quality with sensitivity towards subjects within the scope of the studies		

## Expected results from this subject

Expected results from this subject	Training and Learning Results		
Understanding of the equations and general principles of the continuum, as well as the adequate selection of the different behavior models for deformable solids.	A2	C26 C33	D4 D5 D11
Analysis of solids and structures subjected to stresses above the elastic limit and cyclic loads.	A3	C20	D4 D6 D8 D11

Knowledge, understanding, application, analysis and synthesis of the theory of structures.	A3	C26 C33	D3 D4 D5 D6 D8 D11
Knowledge of the most outstanding aspects of structural behavior in aircraft	A2 A3	C20 C26 C33	D4 D5 D8

## Contents

Topic	
Introduction to the characteristics and configuration of the aeronautical structures.	- Loads on the structure. - Structural elements. Structure of the fuselage: monocoque, semimonocoque. Structure of wing and of tail.
Symmetrical structures.	- Symmetrical structures.
Efforts produced by bending moments and shear forces	- Theorem of the sharp flow. - Sharp efforts. - Combined bending in symmetrical structures.
Torsion.	- Sections no circular. Rectangular section. - Open sections of small thickness. Enclosed sections of small thickness. Enclosed multicellular sections. - Centre of torsion. - Bending-Torsion.
Analysis of tensions in wings.	- Analysis of tensions in wings.
Analysis of tensions in fuselages.	- Analysis of tensions in fuselages.
Introduction to the structural integrity	- Requirements of resistance and rigidity. Factor last of security. - Fatigue. Criteria of fatigue based in tensions. - Criteria of fatigue based in deformations. - Introduction to the mechanics of the fracture. Criteria of tolerance to the damage. Margin of security and factor of reservation.
Elements subjected to axial forces and bending moments	- Elements subjected to axial forces and bending moments. Ultimate bending moment.
Problems of buckling and instabilities.	- Introduction to the theory of the stability - Global buckling. Primary instability of columns of stable section. - Beam-column buckling. Crippling. - Instability of flat and curved panels - Local buckling of of thin wall beams - Stiffened panels. Failure modes for compression and shearing.
Unions in aeronautical structures.	- Unions in aeronautical structures.
Theory of plates and shells	- Structural elements type plate and shell. - Basic hypotheses of calculation. - Flexure of plates and shells. - Plate buckling.
Finite elements method (FEM).	- Linear static analysis with elements type sweep, elasticity 2D and 3D, plates and shells. - Introduction to software of FEM simulation - Structural instability. Buckling by FEM. - Introduction to the static analysis no-linear of structures: no-geometrical linearity, no-linearity of the material (plasticity), no-linearity been due to boundary conditions.

## Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	47	56	103
Laboratory practical	24	30	54
Autonomous problem solving	0	60.5	60.5
Essay questions exam	3.5	0	3.5
Objective questions exam	2	0	2
Problem and/or exercise solving	2	0	2

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Lecturing	Exhibition in the classroom of the basic knowledges of the matter.

Laboratory practical	Realisation of practices in laboratory and/or resolution of practical problems.
Autonomous problem solving	Resolution of problems and/or exercises of autonomous form by part of the students.

### Personalized assistance

Methodologies	Description
Laboratory practical	In the practices will try in the measure of the possible attend personally to all the doubts that arise along the development of the practices

### Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	Assistance and active participation in the practical classes. Resolution of problems and/or exercises of autonomous form.	10	A2 A3	C20 C26 C33	D3 D4 D5 D8 D11
Essay questions exam	Examination at the end of the course on the whole of the content addressed by the subject.	30	A2	C20 C26 C33	D3 D4 D5 D6 D8
Objective questions exam	Proof that that includes questions with different alternative of answer. The student selects an answer between a number limited of possibilities. In the dates established by the centre when concluding the teaching of the matter.	30	A2 A3	C20 C26 C33	D3 D4 D5 D8
Problem and/or exercise solving	Proof in which the student has to solve a series of problems and/or exercises in a time/condition established/ace by the educational team.	30	A2 A3	C20 C26	D3 D4 D5 D8

### Other comments on the Evaluation

The evaluation will be continuous, unless the students waive it through the relevant official procedure. In this case, the evaluation will be carried out exclusively by means of a written exam, covering 100% of the qualification. This specific approach to evaluation will be called global evaluation. The qualification obtained for the laboratory practices will be kept for the evaluation in the second opportunity and the opportunity for the end of the degree. In these calls, the remaining 90% of the qualification will be obtained through a written exam, on the dates established by the center, about the theoretical and/or practical contents.

Students who officially renounce continuous assessment

In this case, the grade obtained in the final exam will represent 100% of the grade.

The student has the right to opt for the global evaluation according to the procedure and the term established by the center for each call.

Laboratory practices

The face-to-face part corresponding to each practice is carried out on a specific date, so it is not possible to recover the absences. Those practices not carried out in which the student presents an official supporting document (doctor, court,...) due to unavoidable reasons of force majeure will be excused promptly and exceptionally.

Assessment tests

The evaluation test schedule officially approved by the EEAE Center Board can be found on the website: <http://aero.uvigo.es/gl/docencia/exames>. The maximum duration of the exam will be 3 hours if there is no break or 5 hours if there is an intermediate break (with a maximum of 3 hours for each part).

The use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. The fact of introducing an unauthorized electronic device into the exam room will be considered a reason for failing the subject in this academic year and the overall grade will be fail (0.0).

ethical commitment

The student is expected to exhibit appropriate ethical behavior. In the case of detecting unethical behavior (copying, use of unauthorized electronic devices and others) it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade for this academic year will be fail (0.0).

Observation

In case of discrepancy in the versions of this guide between languages, the Spanish version prevails.

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## Sources of information

### Basic Bibliography

E. de la Fuente Tremps, **Introducción al análisis de las Estructuras Aeronáuticas**, 1ª, Garceta, 2014

T. H. G. Megson, **Aircraft Structures for engineering students**, 4ª, Elsevier, 2003

Eugenio Oñate Ibáñez de Navarra, **Cálculo de estructuras por el método de elementos finitos**, CIMNE, 1995

### Complementary Bibliography

S.P. Timoshenko, **Theory of plates and shells**, 1ª, McGraw Hill, 1940

Darrol Stinton, **The anatomy of the aeroplane.**, 1ª, BPS Profesional Book, 1985

John Cutler, **Understanding Aircraft Structures**, 1ª, Blackwell Science, 1992

Bruce K. donalson, **Analysis of Aircraft Structures**, 1ª, MCGRAW-HILL. International Editions, 1993

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## Recommendations

### Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/O07G410V01105

Physics: Physics I/O07G410V01103

Physics: Physics II/O07G410V01202

Mathematics: Linear algebra/O07G410V01102

Mathematics: Calculus I/O07G410V01101

Mathematics: Calculus II/O07G410V01201

Materials science and technology/O07G410V01304

Mathematics: Statistics/O07G410V01401

Classical mechanics/O07G410V01305

Resistance of materials and resilience/O07G410V01405

Thermodynamics/O07G410V01303