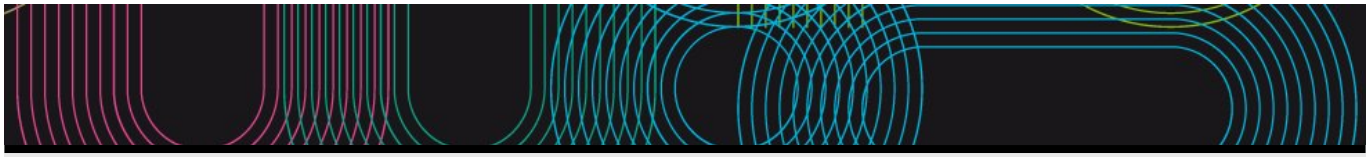

IDENTIFYING DATA				
Solid mechanics and aerospace structures				
Subject	Solid mechanics and aerospace structures			
Code	O07G410V01921			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Comesaña Piñeiro, Rafael Conde Carnero, Borja			
Lecturers	Bendaña Jácome, Ricardo Javier Comesaña Piñeiro, Rafael Conde Carnero, Borja			
E-mail	bconde@uvigo.es racomesana@uvigo.es			
Web	http://http://aero.uvigo.es/			
General description	Introduction to the mechanics of solids and aeronautical structures			

Skills	
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 lenguage
D4	Capability of autonomous learning and information management
D5	Capability to solve problems and draw decisions
D6	Capabiliity for interpersonal communication
D8	Capabiliity for critical and self-critical reasoning
D11	Show motivation for quality with sensitivity towards subjects within the scope of the studies

Learning outcomes			
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	40	17	57
Problem solving	10	0	10
Laboratory practical	25	10	35
Autonomous problem solving	0	119.5	119.5
Essay questions exam	3.5	0	3.5
*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.
Problem solving	Resolution of problems related with the theoretical contents.

Laboratory practical	Realisation of practices in laboratory and/or realisation of practices in computer classroom 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.	90	A2	C20 C26 C33	D3 D4 D5 D6 D8

Other comments on the Evaluation

To pass the subject in the corresponding call (1ª announcement and 2ª announcemen)t it will be required to obtain a qualification equal or higher than 5 points out of 10 in the combination of continuous assesssment and the examination at the official date

The final qualification will be calculated in agreement to the percentages indicated.The assessment schedule is approved officially by the Board of Centre of the *EEAE and published in the web http://aero.uvigo.es/gl/docencia/examesThe maximum duration of the final exam will be of 3 hours if there is not interruption, and 5 hours if there is an intermediate pause (being 3 hours the maximum for each part).
Students that renounce officially to the continuous assessment: the mark obtained in the final examn will represent 100% of the qualification. This examination can include a part to be made in computer classroom and/or laboratory, whose qualification will represent 10% of the total qualification.

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
R. Bendaña, **Ejercicios de Resistencia de Materiales y cáculo de Estructuras para Ingenieros**, 1ª, Galiza Editora, 2005
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

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