# Universida<sub>de</sub>Vigo

#### Subject Guide 2023 / 2024

IDENTIFYIN	G DATA			
Solid mecha	anics and aerospace structures			
Subject	Solid mechanics			
	and aerospace			
	structures			
Code	O07G410V01921			
Study	Grado en			
programme	Ingeniería			
	Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	1st
Teaching	Spanish			
language	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	Introduction to the mechanics of solids and a	aeronautical structures		
description				

#### **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 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

Expected results from this subject			
Expected results from this subject	Tr	aining ar	nd Learning
		Res	ults
Understanding of the equations and general principles of the continuum, as well as the adequate	A2	C26	D4
selection of the different behavior models for deformable solids.		C33	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.	Α3	C26 C33	D3 D4 D5 D6 D8 D11
Knowledge of the most outstanding aspects of structural behavior in aircraft	A2	C20	D4
	A3	C26	D5
		C33	D8

Contents	
Торіс	
Introduction to the characteristics and	- Loads on the structure.
configuration of the aeronautical structures.	<ul> <li>Structural elements. Structure of the fuselage: monocoque,</li> </ul>
	semimonocoque. Structure of wing and of tail.
Symmetrical structures.	- Symmetrical structures.
Efforts produced by bending moments and shear	- Theorem of the sharp flow.
forces	- 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.
	<ul> <li>Criteria of fatigue based in deformations.</li> </ul>
	- 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	- Elements subjected to axial forces and bending moments. Ultimate
moments	bending moment.
Problems of buckling and instabilities.	<ul> <li>Introduction to the theory of the stability</li> </ul>
	- Global buckling. Primary instability of columns of stable section.
	- Beam-column buckling. Crippling.
	<ul> <li>Instability of flat and curved panels</li> </ul>
	<ul> <li>Local buckling of of thin wall beams</li> </ul>
	- Stiffened panels. Failure modes for compression and shearing.
Unions in aeronautical structures.	- Unions in aeronautical structures.
Theory of plates and shells	<ul> <li>Structural elements type plate and shell.</li> </ul>
	- 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 no	ot take into account the het	erogeneity of the students.

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

# Laboratory practicalRealisation of practices in laboratory and/or realisation of practices in computer classroom and/or<br/>resolution of practical problems.Autonomous problemResolution of problems and/or exercises of autonomous form by part of the students.

solving

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. 10 A2 C20 D3 Resolution of problems and/or exercises of autonomous form. C26 Α3 D4 C33 D5 D8 D11 Essay questions Examination at the end of the course on the whole of the content 30 A2 C20 D3 addressed by the subject. C26 D4 exam C33 D5 D6 D8 **Objective questions** Proof that that includes questions with different alternative of answer. 30 A2 C20 D3 exam The student selects an answer between a number limited of Α3 C26 D4 possibilities. In the dates established by the centre when concluding the C33 D5 teaching of the matter. D8 Problem and/or Proof in which the student has to solve a series of problems and/or 30 A2 C20 D3

### 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.

exercises in a time/condition established/ace by the educational team.

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

exercise solving

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

A3

C26

D4 D5 D8 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.

# 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

## Recommendations

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

Graphic expression: Graphic expression/007G410V01105 Physics: Physics I/007G410V01103 Physics: Physics II/007G410V01202 Mathematics: Linear algebra/007G410V01102 Mathematics: Calculus I/007G410V01101 Mathematics: Calculus II/007G410V01201 Materials science and technology/007G410V01304 Mathematics: Statistics/007G410V01401 Classical mechanics/007G410V01305 Resistance of materials and resilience/007G410V01405 Thermodynamics/007G410V01303