



IDENTIFYING DATA

Aerodynamics and aeroelasticity

Subject	Aerodynamics and aeroelasticity			
Code	007G410V01923			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Navarro Medina, Fermín			
Lecturers	Navarro Medina, Fermín			
E-mail	fermin.navarro.medina@uvigo.es			
Web	http://aero.uvigo.es			
General description	<p>The subject includes the aerodynamic forces that determine the dynamics of the flight and the role of the different variables involved in the aerodynamic phenomena of profiles, wings, and nozzles, considering both compressible and incompressible flow. An introduction to aeroelasticity is also made.</p> <p>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.</p>			

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
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
C20	Appropriate knowledge applied to engineering: mechanics of fracture of the continuous media and their dynamic behavior, fatigue of structural instability and aeroelasticity.
C22	Appropriate knowledge applied to engineering: foundations of fluid mechanics that describe the flow in all regimes, to determine the distributions of pressures and forces on an aircraft.
C25	Appropriate knowledge applied to engineering: methods of design calculations and aeronautical projects; use of aerodynamic experimentation and the most significant parameters in the theoretical application; management of experimental techniques, equipment and measuring instruments; simulation, design, analysis and interpretation of experimentation and operations in flight; systems of maintenance and certification of aircrafts.
C26	Applied knowledge of aerodynamics; mechanics and thermodynamics, flight mechanics, aircraft engineering (fixed and rotary wings), theory of structures.
C28	Appropriate knowledge applied to engineering: foundations of fluid mechanics that describe the flow in any regime and determine the distribution of pressures and aerodynamic forces.
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
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- Knowledge, understanding, application and analysis of the aerodynamic phenomena and of the laws that govern his performance;	A2 A3	C22 C26 C28	D3 D4
- Knowledge, understanding and synthesis of the foundations of the flight of the aircraft	A3 A5	C22 C25 C26	D5 D6
- Knowledge, understanding, application, analysis and synthesis of the methods applied to the study of aeroelasticity;	A2 A3	C20 C25 C28	D8 D11
- Knowledge, understanding, application, analysis and synthesis of the aeroelasticity of a profile, from the static point of view (problems of torsional divergence and of investment of control) and dynamic (problems of flutter and buffet)	A3 A5	C20 C25 C28	D3 D4
- Knowledge, understanding, application, analysis and synthesis of aeroelasticity of one-dimensional and two-dimensional structures.;	A3	C20 C22 C26	D6 D8
- Knowledge and understanding of the most important appearances of experimental aeroelasticity, and more specifically of the essays in earth and in flight of aerostructures	A5	C20 C25	D8

Contents

Topic	
1. Aerodynamics of flow incompressible	Subject 1.1: Introduction Subject 1.2: Foundations and principles of the aerodynamic Subject 1.3: Foundations of the flow incompressible Subject 1.4: Flow incompressible on profiles Subject 1.5: Flow incompressible on finite wings Subject 1.6: Flow incompressible three-dimensional
2. Aerodynamics of compressible flow	Subject 2.1: Aerodynamics in subsonic and supersonic regimes Subject 2.2: linear Theory of compressible flow in profiles
3. Aeroelasticity	Subject 3.1: Introduction to the aeroelasticity Subject 3.2: Aeroelasticity static Subject 3.3: Aeroelasticity dynamic

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practical	15	10	25
Previous studies	0	26.5	26.5
Mentored work	8	25	33
Problem solving	18.5	55	73.5
Workshops	2	0	2
Lecturing	30	10	40
Problem solving	1.5	0	1.5
Objective questions exam	3.5	0	3.5
Report of practices, practicum and external practices	0	20	20

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

Methodologies

	Description
Laboratory practical	Realisation of practices programmed using the wind tunnel and manufacturing processes of test models. The realisation of the practice requires the preparation of it by means of a previous design, the assistance to the sessions of practices and the realisation of a report by the students.
Previous studies	Study of the student of autonomous form, with the support of the professor if like this it requires it according to the procedures established by the university
Mentored work	The mentored work consists on the development of a aerodynamic project based on aircraft airfoils and wings. The work is done by groups of students, and they have booked sessions with the professor for monitoring and tutoring. The work is coordinated with other one in the subject Fixed-wing and rotary wing aircrafts.
Problem solving	Resolution of problems and/or exercises that treat punctual appearances of the contents of the course, developed by the professor and/or the students in the classroom
Workshops	Workshop of software of aerodynamic simulation, whose utilisation serves of support for the rest of the subject, so much for the resolution of problems, as for the preparation of the practices.
Lecturing	Exhibition of a subject or resolution of problems by part of the professor according to a previously established script
Problem solving	Partial exam 1 based on the resolution of problems and/or conceptual questions about the contents of the subject between topics 1 and 2.

Personalized assistance	
Methodologies	Description
Previous studies	The student studies of autonomous form, with the support of the professor if like this it requires it according to the procedures established by the university
Workshops	Workshop of software of aerodynamic simulation, whose utilisation serves of support for the rest of the subject, so much for the resolution of problems, as for the preparation of the practices. The workshop will be guided by the professor of the subject.

Assessment					
	Description	Qualification	Training and Learning Results		
Mentored work	The mentored work consists on the development of a aerodynamic project based on aircraft airfoils and wings. The work is done by groups of students, and they have booked sessions with the professor for monitoring and tutoring.	35	A2 A3	C20 C22 C26 C28	D3 D4 D5 D6 D8
Problem solving	(*)Examen parcial 1 basado en la resolución de problemas y/o preguntas conceptuales sobre los contenidos de la asignatura de entre los temas 1 y 2. Se puede recuperar en una prueba sobre los mismos temas, el día del examen en fecha oficial si la nota del parcial es inferior a 5.0.	30			
Objective questions exam	Resolution of problems and/or conceptual questions on the contents of the subject (intermediate exam 5% and final exam 55%)	30	A2 A3 A5	C20 C22 C25 C26 C28	D3 D4 D5
Report of practices, practicum and external practices	Report of the works made in the laboratory, and of the design of the profile and the wing.	5	A2 A3 A5	C20 C22 C25 C26 C28	D3 D4 D6 D11

Other comments on the Evaluation

First call

In order to pass the subject on the 1st opportunity, it will be necessary to obtain a score greater than 5 points out of 10 in the joint evaluation of the continuous assessment during the development of the classes and the exam on the official date. In addition, the qualification of the partial exam 1 (or of the recovery on the official date) together with that of the partial exam 2 must be greater than 5 points out of 10. The final qualification of the continuous evaluation will be obtained according to the indicated percentages. In the case of not fulfilling both conditions, the final mark will be the result of the minimum of the average mark of continuous evaluation and 4.0.

For the exam-only assessment, an exam will be carried out on the day of the official date, which includes all the contents of the subject. The qualification of said exam to pass the subject will be 5 points out of 10.

The evaluation testing calendar officially approved by the EEAE Center Board is published on the web <http://aero.uvigo.es/gl/docencia/exames>

Continuous assessment tests will be carried out during school hours"

The student has the right to opt for the global assessment according to the procedure and the deadline established by the centre for each call.

Second call

The student must submit to the extraordinary exam of all the contents of the subject, which will be 100% of the grade, if the final grade of continuous assessment is less than 5 points out of 10.

You will also have to take the ordinary exam in the following cases : Obtain a grade below 5 points out of 10 in the final exam of continuous evaluation.

End-of-program call

For the end of degree evaluation, an exam will be held on the day of the official date, which includes all the contents of the subject. The qualification of said exam to pass the subject will be 5 points out of 10.

Sources of information

Basic Bibliography

John D. Anderson Jr, **Fundamentals of Aerodynamics**, McGraw-Hill Education, 2016

John J. Bertin, **Aerodynamics for engineers**, Pearson, 2013

Raymond L. Bisplinghoff, **Principles of Aeroelasticity**, Dover Books, 2013

José Meseguer Ruiz, Ángel Sanz Andrés, **Aerodinámica básica**, 2ª, Gaceta, grupo editorial, 2010

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Mechanics of flight/O07G410V01924

Subjects that are recommended to be taken simultaneously

Fluid mechanics II and CFD/O07G410V01922

Subjects that it is recommended to have taken before

Physics: Physics I/O07G410V01103

Physics: Physics II/O07G410V01202

Fluid mechanics/O07G410V01402
