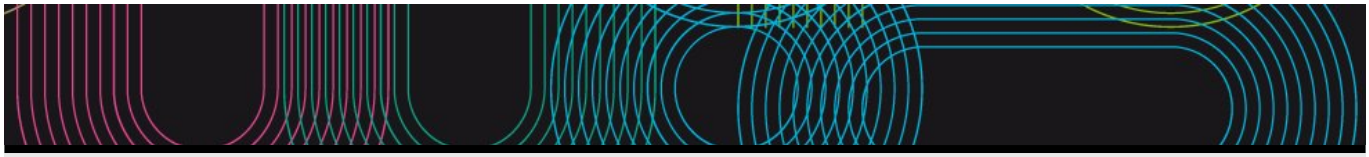

IDENTIFYING DATA				
Aerodynamics and aeroelasticity				
Subject	Aerodynamics and aeroelasticity			
Code	O07G410V01923			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Navarro Medina, Fermín			
Lecturers	Navarro Medina, Fermín			
E-mail	fermin.navarro.medina@uvigo.es			
Web	http://aero.uvigo.es			
General description	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. 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.			

Competencies	
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 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

- Knowledge, understanding, application and analysis of the aerodynamic phenomena and of the laws that govern his behaviour; - Knowledge, understanding and synthesis of the foundations of the flight of the aircraft - Knowledge, understanding, application, analysis and synthesis of the methods applied to the study of aeroelasticity; - 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) - Knowledge, understanding, application, analysis and synthesis of aeroelasticity of one-dimensional and two-dimensional structures.; - Knowledge and understanding of the most important appearances of experimental aeroelasticity, and more specifically of the essays in earth and in flight of aerostructures	A2 A3	C22 C26 C28	D3 D4
New	A3 A5	C22 C25 C26	D5 D6
New	A2 A3	C20 C25 C28	D8 D11
New	A3 A5	C20 C25 C28	D3 D4
New	A3	C20 C22 C26	D6 D8
New	A5	C20 C25	D8

Contents

Topic	
1. Aerodynamics of uncompressible flow	Subject 1.1: Introduction Subject 1.2: Foundations and principles of the aerodynamic Subject 1.3: Foundations of the uncompressible flow Subject 1.4: Uncompressible flow on airfoils Subject 1.5: Uncompressible flow on finite wings Subject 1.6: Three-dimensional uncompressible flow
2. Aerodynamics of compressible flow	Subject 2.1: Foundations of the compressible flow Subject 2.2: Waves of crash Subject 2.3: compressible Flow in nozzles and diffusing Subject 2.4: linear Theory of compressible flow in airfoils
3. Aeroelasticity	Subject 3.1: Introduction to aeroelasticity Subject 3.2: Aeroelasticity of airfoil and one-dimensional structures Subject 3.3: Aeroelasticity of two-dimensional structures Subject 3.4: Experimental aeroelasticity

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practical	15	0	15
Previous studies	0	126.5	126.5
Seminars	4	0	4
Problem solving	20	0	20
Workshops	6	0	6
Lecturing	30	0	30
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 a practice programmed using the wind tunnel and the hot thread cutting machinne and other processes of manufacture. The realisation of the practice requires the preparation of the same by means of a previous design, the assistance to the sessions of practices and the realisation of a report by part of the group of 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

Seminars	The seminars consist in the realisation of exercises in groups of students and individually, that will have to resolve during the time of the seminar. So much the conjoint resolution of the exercise, like the individual contribution will be valued. They will make two asset seminars during the course.
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

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		
Seminars	The seminars consist in the realisation of exercises in groups of students and individually, that will have to resolve during the time of the seminar. So much the conjoint resolution of the exercise, like the individual contribution will be valued. They will make two asset seminars during the course.	5	A2 A3	C20 C22 C26 C28	D3 D4 D5 D6 D8
Objective questions exam	Resolution of problems and/or conceptual questions on the contents of the subject	60	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.	35	A2 A3 A5	C20 C22 C25 C26 C28	D3 D4 D6 D11

Other comments on the Evaluation

Continuous assessment

To pass the subject in the evaluation in the 1st call will be required to obtain a grade higher than 5 points out of 10 in the joint assessment of the continuous evaluation during the development of the classes and the exam on the official date.

The official exam grade must be greater than 5 points out of 10.

The final grade will be obtained according to the percentages indicated.

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

The maximum duration of the exam will be 3 hours if there is no interruption or 5 hours if there is an intermediate break (3 hours maximum for each part).

Extraordinary exam

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 :- The non-performance or delivery of any of the points of the continuous evaluation.

- Obtain a grade below 5 points out of 10 in the final exam of continuous evaluation.

Sources of information

Basic Bibliography

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

John J. Bertín, **Aerodynamics for engineers**, Pearso, 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

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===
In front of the uncertain and unpredictable evolution of the sanitary alert caused by the *COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide *antelación) by the students and the *profesorado through the tool normalised and institutionalised of the educational guides.

=== ADAPTATION OF THE METHODOLOGIES ===
* educational Methodologies that keep
ALL except the practices of laboratory. The methodologies that keep will be adapted to the available technological resources (remote campus, virtual blackboard, etc). The work *tutelado also can carry out on-line, without more than substituting the face-to-face meetings *grupales and the sessions *tutorizadas with the professor by telematic meetings.

* Educational methodologies that modify
The practices of laboratory will be substituted by a bulletin of problems of character researcher

* Mechanism no face-to-face of attention to the students (tutoring sessions)
virtual office of the remote campus

* Modifications (if they proceed) of the contents to give
ANY

* additional Bibliography to facilitate the car-learning
Can use the same references

* Other modifications

=== ADAPTATION OF THE EVALUATION ===
* Test already made
Tests Examination of objective questions: [previous Weight 60%] [Weight Proposed 60%]
Tests Seminar: [previous Weight 5%] [Weight Proposed 5%]
Tests Report of practices, *prácticum and external practices: [previous Weight 35%] [Weight Proposed 35%]

* pending Proofs that keep
Tests Examination of objective questions: [previous Weight 60%] [Weight Proposed 60%]
Tests Seminar: [previous Weight 5%] [Weight Proposed 5%]

* Proofs that modify
Proof Inform of practices, prácticum and external practices: [previous Weight 35%] [Weight Proposed 30%]. The work *tutelado included in this proof is the one who evaluates .

* New proofs
Tests Resolution of problems and/or exercises: [previous Weight 0%] [Weight Proposed 5%]. The problems will deliver in shape of bulletin, with a date established in the moment of the delivery.

* Additional information
will inform of the links and the keys to access to the virtual classroom and to the virtual dispatch. The tutoring sessions will be in the virtual office, after previous agreement of the date and hour via mail.