



## IDENTIFYING DATA

### Advanced aerodynamics and aeroelasticity

Subject	Advanced aerodynamics and aeroelasticity			
Code	O07M197V01101			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Navarro Medina, Fermín			
Lecturers	Navarro Medina, Fermín			
E-mail	fermin.navarro.medina@uvigo.es			
Web	<a href="http://aero.uvigo.es">http://aero.uvigo.es</a>			
General description	The subject of "advanced aerodynamics and aeroelasticidad" deepens in in the methods of calculation of the aerodynamic and aeroelastic loads that a fluid exerts on aerodynamic, slender and blunt bodies in distinct ranges of flight ranges of aircraft. It deepens also in the aerodynamic phenomena in subsonic, transonic, supersonic and hypersonic flight of aircraft or other vehicles, and in static and dynamic aeroelastic phenomena.			

## Training and Learning Results

Code	
A3	Understanding and mastering the laws of external aerodynamics in different flight regimes, and application to numerical and experimental aerodynamics
A4	Application of knowledge acquired in different disciplines to solve complex aeroelasticity problems
A9	Ability to design, execute and analyze ground and flight tests of aerospace vehicles, and to carry out a complete aerospace vehicle certification process.
A14	Understanding and mastery of the laws of internal aerodynamics, as well as their application, together with other disciplines, to the resolution of complex aeroelasticity and propulsive systems problems.

## Expected results from this subject

Expected results from this subject	Training and Learning Results
Knowledge and understanding of the potential theory of subsonic and supersonic wings.	A3 A14
Capacity to resolve aerodynamic problems applying the knowledges learnt.	A3 A14
Knowledge, understanding, application, analysis and synthesis of the methods applied to the study of the respond of aircraft unsteady loads.	A3 A4 A9
Knowledge, understanding, application, analysis and synthesis of the methods applied to the aeroelastic study.	A4
Knowledge, understanding, application, analysis and synthesis of aeroelasticity for wings, from a static and dynamic point of view.	A4 A9
Knowledge and understanding of the most important phenomena of the experimental aeroelasticity.	A4 A9

## Contents

Topic
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1. Subsonic aerodynamics	<ul style="list-style-type: none"> <li>o Potential theory of wings in a subsonic compressible regime.</li> <li>o Subsonic and supersonic air intakes.</li> <li>o Numerical techniques of whirlwind methods.</li> <li>o Experimental techniques (wind tunnels, instrumentation and test techniques).</li> </ul>
2. Supersonic aerodynamics	<ul style="list-style-type: none"> <li>o Transonic phenomena in profiles and wings.</li> <li>o Supersonic wing power theory.</li> <li>o Potential theory of slender bodies.</li> <li>o Subsonic and supersonic air intakes.</li> <li>o Hypersonic regime</li> </ul>
3. Static aeroelasticity	<ul style="list-style-type: none"> <li>o Continuous systems and discrete systems. Forced vibrations of continuous systems.</li> <li>o Approximate methods for solving continuous systems. Static aeroelasticity of the wings. Divergence and reversal of command.</li> </ul>
4. Dynamic aeroelasticity	<ul style="list-style-type: none"> <li>o Dynamic aeroelasticity of wings.</li> <li>o Advanced aeroelasticity. Aeroelasticity in the Laplace domain. Nonlinear aeroelasticity. Aeroservoelasticity.</li> <li>o Structural dynamics and aeroelasticity tests. Aeroelastic tests in flight.</li> </ul>

### Planning

	Class hours	Hours outside the classroom	Total hours
Case studies	10	60	70
Laboratory practical	2	2	4
Lecturing	29	0	29
Problem solving	4.5	0	4.5
Autonomous problem solving	0	10	10
Previous studies	0	30	30
Objective questions exam	1.5	0	1.5
Presentation	1	0	1

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

### Methodologies

	Description
Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished and delivered by the students outside the classroom. The case studies will require the use of software and/or the wind tunnel.
Laboratory practical	Realization of programmed practices using the wind tunnel. The realization of the practical requires the preparation of the same by means of a previous design, the assistance to the practical sessions and the realization of a report on the part of the group of students.
Lecturing	Presentation of a topic or resolution of problems by the teaching staff according to a previously established script.
Problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the teaching staff and/or the students in the classroom
Autonomous problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the students outside the classroom
Previous studies	Students study autonomously, with the support of the teaching staff if required according to the procedures established by the university for tutorials

### Personalized assistance

Methodologies	Description
Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished and delivered by the students outside the classroom. The students will have the necessary tutorials with the teaching staff to monitor the development of the case studies.
Previous studies	Support tutorials for students to study independently, according to the procedures established by the university.

### Assessment

Description	Qualification Training and Learning Results

Case studies	Five study cases for the resolution of which software and/or experimentation will be used. The qualification of each of them will be 10% (three of the study cases), and 15% (two of the study cases).	60	A3 A4 A9 A14
Objective questions exam	Exam based on the resolution of problems and/or conceptual questions about the contents of the subject. It will be on the official exam date. Minimum note of 5.0.	35	A3 A4 A9 A14
Presentation	Presentations of the results of the case studies to be carried out by the students throughout the course.	5	A3 A4 A14

## Other comments on the Evaluation

### First call

To pass the subject on the 1st opportunity, it will be necessary to obtain a score of more than 5 points out of 10 in the joint evaluation of the continuous evaluation during the development of the classes and the exam on the official date. In addition, the exam grade on the official date must be greater than or equal to 5 points out of 10. The final grade of the continuous assessment will be obtained according to the indicated percentages.

For the global evaluation, an exam will be carried out on the day of the official date, which includes all the contents of the subject, including the contents and methods used in the case studies. The qualification of said exam to pass the subject will be 5 points out of 10.

The evaluation test schedule officially approved by the Junta de Centro da EEAE 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 take the second call exam of all the contents of the subject, which will mean 100% of the grade, if the final continuous assessment grade is less than 5 points out of 10. They will also have to sit the second call exam in the following cases:

- Obtain a grade of less than 5 points out of 10 in the first chance final exam

In case of obtaining a grade greater than or equal to 5 in the second chance exam, the final grade for the subject will be the highest grade between:

- \* the 2nd call exam

- \* the average with the activities carried out during the course (averaging with the percentages of the evaluation table substituting the mark of the first call exam for the second call)

### 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

A. Barrero Ripoll, **Aerodinámica de altas velocidades**, 978-84-9281-246-21, Garceta Grupo Editorial, 2011

### Complementary Bibliography

Wright, J.R. and Cooper, J.E., **Introduction to Aircraft Aeroelasticity and Loads**, 978-0470-85840-0, John Wiley & Sons Ltd. 2007, 2007

## Recommendations

### Subjects that continue the syllabus

Advanced fluid mechanics/O07M197V01201

**Subjects that are recommended to be taken simultaneously**

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Advanced fluid mechanics/O07M197V01104

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