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220351 - Advanced Aeroelasticity

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering

Academic year: 2018

Degree: MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Teaching unit Optional)
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Roberto Flores

Prior skills

A basic understanding of low-speed aerodynamics and structural dynamics is required.

Requirements

Thus subject must be ALWAYS be followed together with the ADVANCED AERODYNAMICS (220352) course.

Degree competences to which the subject contributes

Specific:

CEEVEHI1. MUEA/MAS: Sufficient applied knowledge of advanced, experimental and computational aerodynamics (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI2. MUEA/MAS: Sufficient applied knowledge of the aeroelasticity and structural dynamics of aircraft (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI3. MUEA/MASE: Applied knowledge of composite materials technology and a capacity for designing the basic elements of these materials (specific competency for the specialisation in Aerospace Vehicles).

Teaching methodology

- Theory lessons: During these lectures the teacher will introduce the theoretical basis, analysis methods and important results. Where appropriate, illustrative examples will be discussed to improve the student's understanding of the subject.

- Practice lessons: During the practice sessions the student will solve, under supervision of the teacher, review exercises in order to gain experience in the application of the analysis methods taught during the theoretical lectures.

- Exams: During the exam sessions the student will demonstrate his understanding of the theory and problem solving skills. There will be an exam for each of the course modules.

- Self-study: While the teacher will present a short overview of the subjects in the classroom, it remains the duty of the student to gain a more in-deep understanding by going over the recommended references. This is fundamental in order to acquire the necessary abilities of critical thinking and autonomous problem-solving.

Learning objectives of the subject

This course serves as an introduction to the field of aeroelasticity. The course starts with a short review of the foundations of low-speed aerodynamics and vibration analysis. The students will then be presented with a qualitative overview of static and dynamic aeroelastic phenomena typical of hypersonic flows. Some numerical analysis techniques suitable for obtaining approximate solutions will also be introduced.

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Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours small group:	15h	12.00%
	Self study:	80h	64.00%

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Content

Module 1: Review of low speed aerodynamics and vibration analysis

Learning time: 39h

Theory classes: 10h
Practical classes: 5h
Self study : 24h

Description:
Basic equations of fluid dynamics:
- Simplifications for high-Re and low-M flows
- Approximate solution methods
Fundamentals of structural analysis and vibration analysis:
- Basic structural theory
- Vibrations of discrete systems

Related activities:
Theory lessons
Practice lessons
Module 1 exam

Module 2: Steady aeroelastic phenomena

Learning time: 43h

Theory classes: 10h
Practical classes: 5h
Self study : 28h

Description:
Introduction to static aeroelastic phenomena:
- Torsional divergence
- Control reversal
Approximate solution methods

Related activities:
Theory lessons
Practice lessons
Module 2 exam

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Module 3: Unsteady aeroelastic phenomena	Learning time: 43h Theory classes: 10h Practical classes: 5h Self study : 28h

Description:
Introduction to dynamic aeroelastic phenomena:
- Gust response
- Flutter
- Buffeting

Approximate solution methods

Related activities:
Theory lessons
Practice lessons
Module 3 exam

Qualification system

In principle, the final course grade is a weighted average of the grades awarded in the exams of the 3 course modules. However, the final exam includes all the contents of the course, so it serves also as a retake for students whose average grade is not satisfactory. The final course grade shall be the maximum of the weighted average and the final exam result:

Final grade = MAX(Exam_3, Average_grade)
where
Average_grade 0,30·Exam_1 + 0,35·Exam_2 + 0,35·Exam_3

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

Bibliography

Basic:

Clark, Robert [et al.]. A modern course in aeroelasticity [on line]. 4th ed. Dordrecht; Boston: Kluwer Academic Publishers, 2004 [Consultation: 27/06/2016]. Available on: <http://link.springer.com/book/10.1007/1-4020-2106-2>. ISBN 1402020392.

Complementary:

Katz, J.; Plotkin, A. Low speed aerodynamics. 2nd ed. Cambridge: Cambridge University Press, 2001. ISBN 0521665523.

Timoshenko, Stephen. Vibration problems in engineering. 2nd ed. New York: Lulu Com, 2012. ISBN 9781105528422.