Last update: 09-07-2018

300276 - AER - Aerodynamics

Coordinating unit: 300 - EETAC - Castelldefels School of Telecommunications and Aerospace Engineering

Teaching unit: 748 - FIS - Department of Physics

Academic year: 2018

Degree: BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERINGS/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING - NETWORK ENGINEERING (AGRUPACIÓ DE SIMULTANEÏTAT) (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN AEROSPACE SYSTEMS ENGINEERING/BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)

ECTS credits: 4,5 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: Definit a la infoweb de l'assignatura.

Others: Definit a la infoweb de l'assignatura.

Requirements

Prerequisites: THERMODYNAMICS, FLUID MECHANICS

Degree competences to which the subject contributes

Specific:

3. CE 19 AERO. Conocimiento aplicado de: la ciencia y tecnología de los materiales; mecánica y termodinámica; mecánica de fluidos; aerodinámica y mecánica del vuelo; sistemas de navegación y circulación aérea; tecnología aeroespacial; teoría de estructuras; transporte aéreo; economía y producción; proyectos; impacto ambiental. (CIN/308/2009, BOE 18.2.2009)
1. CE 16 AERO. Conocimiento adecuado y aplicado a la Ingeniería de: Los conceptos y las leyes que gobiernan los procesos de transferencia de energía, el movimiento de los fluidos, los mecanismos de transmisión de calor y el cambio de materia y su papel en el análisis de los principales sistemas de propulsión aeroespaciales. (CIN/308/2009, BOE 18.2.2009)
2. CE 18 AERO. Conocimiento adecuado y aplicado a la Ingeniería de: Los fundamentos de la mecánica de fluidos; los principios básicos del control y la automatización del vuelo; las principales características y propiedades físicas y mecánicas de los materiales. (CIN/308/2009, BOE 18.2.2009)

Transversal:

5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
7. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
8. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
9. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

Last update: 09-07-2018

300276 - AER - Aerodynamics

06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

Learning objectives of the subject

- Identificar els règims de compressibilitat i turbulència de fluxos aerodinàmics i les equacions associades a una situació de vol qualsevol.
- Identificar l'origen de les forces aerodinàmiques resultants de fluxos externs.
- Resoldre analíticament problemes simples d'aerodinàmica.
- Interpretar correctament resultats experimentals en aerodinàmica.

Study load

Total learning time: 112h 30m	Hours large group:	24h	21.33%
	Hours medium group:	15h	13.33%
	Guided activities:	10h 30m	9.33%
	Self study:	63h	56.00%

Last update: 09-07-2018

300276 - AER - Aerodynamics

Content

Introduction to aerodynamics

Learning time: 18h

Theory classes: 4h
Practical classes: 3h
Guided activities: 1h
Self study : 10h

Description:
- Introduction
- General equations of fluid motion: Navier-Stokes equations
  - Continuity equation
  - Newton ' s 2nd Law
  - Energy equation
- Simplifications
- Euler, Euler-Bernoulli and Bernoulli equations
- Differential equation for the velocity potential

Inviscid aerodynamics

Learning time: 44h

Theory classes: 10h
Practical classes: 6h
Guided activities: 2h
Self study : 26h

Description:
PART 1:
- Introduction
- Aerodynamic forces acting on an airfoil in stationary 2D potential flow:
  - D'Alembert's paradox
    - Kutta-Yukovski theorem
- Viscosity effects
- Sharp trailing edge
- Hypothesis of Kutta
- Generation of circulation
- Lift, drag & pitching moment coefficient

PART 2:
- Introduction
- Mathematical approach
- Linearization
- Symmetric problem
- Lifting/camber problem

PART 3:
- Introduction
- Lanchester-Prandtl wing theory:
  - Wing global lift
  - Wing global lift coefficient
  - Induced drag

Last update: 09-07-2018

300276 - AER - Aerodynamics

Viscous aerodynamics: Boundary layer	Learning time: 46h Theory classes: 10h Practical classes: 6h Guided activities: 3h Self study : 27h

Description:
Part 1: Introduction
Viscous effects in aerodynamics
Drag Coefficient of flow around various objects
Shortcomings of potential flow theory
Part 2: Laminar Boundary Layer
Boundary Layer Hypothesis
Equations
Solution methods
Part 3: Turbulent Boundary Layer
Transition & turbulent flows
Equations
Solution methods
Turbulent boundary layer structure
Part 4: Extensions to boundary layer theory
Compressible boundary layer
3-dimensional boundary layer
Laminar-turbulent transition

buffer (exams and others)	Learning time: 4h 30m Guided activities: 4h 30m

Description:
buffer

300276 - AER - Aerodynamics

Bibliography

Basic:

Anderson, John David. Fundamentals of aerodynamics. 3rd ed. Boston [etc.]: McGraw-Hill, 2001. ISBN 0072373350.

White, Frank M. Mecánica de fluidos. 6ª ed. Madrid [etc.]: McGraw-Hill, cop. 2008. ISBN 9788448166038.

Oertel, Herbert. Prandtl-Essentials of Fluid Mechanics [on line]. New York, NY: Springer New York, 2010 [Consultation: 04/07/2018]. Available on: <http://dx.doi.org/10.1007/978-1-4419-1564-1>. ISBN 9781441915641.

Complementary:

Cousteix, J. Modeling and Computation of Boundary-Layer Flows. New York: Springer, 2005.

White, Frank M. Viscous fluid flow. 3rd ed. New York [etc.]: McGraw-Hill, 2006. ISBN 007124493X.

Schlichting (Deceased), Hermann; Gersten, Klaus. Boundary-Layer Theory [on line]. 9th ed. 2017. Berlin, Heidelberg: Springer Berlin Heidelberg : Imprint: Springer, 2017 [Consultation: 04/07/2018]. Available on: <http://dx.doi.org/10.1007/978-3-662-52919-5>. ISBN 9783662529195.

Cebeci, Tuncer; Cousteix, Jean. Modeling and computation of boundary-layer flows : laminar, turbulent and transitional boundary layers in incompressible and compressible flows. 2nd rev. and ext. ed. Long Beach, California : Berlin: Horizons ; Springer, 2005. ISBN 354024459X.

de Iaco Veris, Alessandro. Practical Astrodynamics. First edition. Cham: Springer, [2017]. ISBN 9783319622194.

Others resources:

- Presentacions de classe
- Col·lecció de problemes
- Material multimèdia
- Guió de pràctiques de laboratori