ISEL
ADEM
Área Departamental de Engenharia Mecânica

Curricular Unit Form (FUC)

Course:	**MECHANICAL ENGINEERING**						
Curricular Unit (UC)	**Aerodynamics**				Mandatory		
					Optional	**X**	
Scientific Area:	**Energy and Systems Control**						Ener
Year: **3rd**	Semester:**1st**	ECTS: **4**		Total Hours: **108**			
Contact Hours:	T:	TP: **45**	PL:	S:	OT:	TT:	
Professor in charge		Academic Degree		Position			
Gonçalo Duarte		**Doctor**		**Assistent(?) Professor**			

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

Entry into Force	Semester: **Winter**	Academic Year: **2017/2018**

Objectives of the curricular unit and competences (max. 1000 characters)

This curricular unit provides a comprehension of aerodynamics fundaments in different applications. Tools and methods for problem analysis and assessment on aerodynamics and fluid mechanics will be provided, regarding its applications on engineering. After the conclusion of the course, the student will be able to:
- Understand, analyze and solve problems of external aerodynamics;
- Understand the causes that originate aerodynamic forces and the influence of viscous friction;
- Generally assess aerodynamic drag and lift under several applications;
- Evaluate the impacts on specific applications (e.g. planes, vehicles, etc.)

Syllabus (max. 1000 characters)

- Standard atmosphere: hydrostatic equation, definition of standard atmosphere; temperature, pressure and density altitudes.
- Fluid mechanics basics: Reynolds Transport theorem, Bernoulli, Navier-Stokes.
- Aerodynamics basics: speed of sound; measuring air speed in compressible and incompressible flows and supersonic flow; compressibility effects; laminar and turbulent boundary layer, flow separation.
- Wing and airfoil theory: airfoils, wings and other aerodynamic shapes; NACA airfoils; pressure coefficient.
- Potential flow; Kutta-Joukowski theorem; wing profiles.
- Computational methods in Aeordynamics.

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Demonstration of the syllabus coherence with curricular unit's objectives (max. 1000 characters)
The course aims to deepen some areas of knowledge, however, the programmatic content is focused on specific objectives, namely: • Expanding Fluid Mechanics fundamentals and practical application of theory; • Physical phenomena on Aerodynamics: forces, flow characterization, etc., applied to different geometries; • Analysis of immersed bodies flow, calculations and practical applications, focused on wing bodies. • Drag and Lift (e. g. vehicles, planes, etc.); • Integration of Mechanical Engineering fundamentals, promoting the inter-connection of knowledge. The project report included in the evaluation aims at fulfilling the course objectives, with the analysis of a specific and practical application.

Teaching methodologies (including evaluation) (max. 1000 characters)
The phenomenological discussion of the contents is a priority in the course, with deepen physical component and reducing the use of complex mathematical models, without compromising the analysis, calculations and conclusions obtained. **Evaluation.** One written exam (EXM) and a project report (TRB) with oral presentation. TRB- Project report intends to improve skills development; EXM- Final exam: classifications above 9.5/20, to assure a minimum level of acquired knowledge; Final classification = 0,25xTRB + 0,75xEXM. APPROVAL: Students with Final classification above 9.5/20 Note: Project report should be made by a group of students and, if possible, including other Curricular Units.

Demonstration of the teaching methodologies coherence with the curricular unit's objectives (max. 3000 characters)
The teaching and evaluation methodology used includes theoretical-practical classes, group project and individual written exam. The theoretical-practical classes provide immediate demonstrative support on the lectured contents. Consequently, the classes include theoretical fundamental concepts, followed by practical analysis (problems, calculus, project) to consolidate the acquired knowledge. The practical component also intend to promote the application of theoretical concepts with a structured logical reasoning in order to obtain critical sense of the results. The group project allows the students to work as a team, analyze problems, perform

bibliographic survey, evaluate results, develop conclusions, suggest future improvements, etc. The project includes written report and oral presentation.
The exam is a mandatory individual evaluation of the concepts acquired during the course.

Main Bibliography (max. 1000 characters)

- Course slides
- WHITE, FRANK M., FLUID MECHANICS, FOURTH EDITION, MCGRAW-HILL, INC., 1999, ISBN 0-07-116848-6
- Vasco de Brederode, Fundamentos de Aerodinâmica Incompressível, Edição de autor
- Anderson, John D., Introduction to Flight, 4ª edição- McGraw Hill
- Raymer, Daniel, Simplified Aircraft Design for Homebuilders
- HURT, H.H. AERODYNAMICS FOR NAVAL AVIATORS NAVWEPS 00-80T-80, REPRINTED EDITION, AVIATION SUPLIES & ACADEMINCS INC, USA, 1992.
- DOLE, CHARLES E. E LEWIS, JAMES E.: FLIGHT THEORY AND AERODYNAMICS 2ND EDITION; JOHN WILEY AND SONS, INC, USA, 2000.
- JEPPESEN JAR ATPL (A) 2005 MANUAL - VOLUME 8 PRINCIPLES OF FLIGHT, Jeppesen - Atlanric Flight Training, 2005
- ISBN: 0884873587 KERMODE, A.C., “MECHANICS OF FLIGHT”, 1994

MASSEY, B. S., MECHANICS OF FLUIDS, SIXTH EDITION, CHAPMAN & HALL, 1989, ISBN 0-412-34280-4