AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

Teaching AERODYNAMICS (MOD.1) C.I.

GenCod A005137

Owner professor Giuseppe PASCAZIO

Teaching in italian AERODYNAMICS (MOD.1) C.I.

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SSD code ING-IND/06

Reference course AEROSPACE ENGINEERING

Course type Laurea Magistrale

Credits 6.0

Teaching hours Ore-Attivita-frontale: 54.0

For enrolled in 2019/2020

Taught in 2019/2020

Course year 1

Language INGLESE

Curriculum Percorso comune

Location Brindisi

Semester

Exam type Orale

Assessment

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course provides the fundamentals for the study of gas dynamics and aerodynamics. Starting from the formulation of the fundamental equations of gas dynamics in vector notation, the one-dimensional and quasi-one-dimensional gas dynamics is studied, analyzing the isentropic conditions and the normal shocks, in order to characterize the flow through nozzles. Two-dimensional supersonic flows are then studied taking into account oblique shocks and Prandtl-Meyer expansion waves and finally the flow past airfoils. After recalling the concepts of classical aerodynamics, the approximate solution to several important aerodynamic problems is addressed employing the potential flow assumption. Finally, the study of finite wing theory is carried out.

REQUIREMENTS

Basic knowledge of Calculus (derivatives and integrals), Applied Thermodynamics and Fluid Dynamics

COURSE AIMS

At the end of the course the student must:

- *Know the fundamental equations of gas dynamics in vector notation and their simplification in the simplified case of: one-dimensional flow; quasi-one-dimensional flow; multi-dimensional irrotational flow;*
- *Know how to characterize and calculate the properties of the flow through a normal shock, an oblique shock, an expansion wave*
- *Know how to evaluate the force coefficients in the case of airfoils in a supersonic flow*
- *Know the fundamental aspects of the flow past an airfoil and past a finite wing, along with the evaluation of the force coefficients.*

TEACHING METHODOLOGY

Lectures supported by the use of a computer and a projector

ASSESSMENT TYPE	*Written examination for the application part and oral test.* *In the written test (2 hours) the student is requested to solve two/three exercises concerning the arguments of the course; the test aims to verify the capability of the student to select the appropriate solution approach.* *In the oral test the student has to discuss the theoretical arguments of the course, that the student must demonstrate to know and to be able to explain.*
FULL SYLLABUS	*Basic concepts of fluid dynamics. Fluid properties; flow kinematics; Reynolds' transport theorem; conservation equations in integral and differential form; Bernoulli's equation; Crocco's theorem; boundary layer theory (7 hours).* *Introduction to the basic concepts of aerodynamics (3 hours).* *One-dimensional gas dynamics. Quesi one-dimensional flow equations: compressibility; speed of sound; quasi one-dimensional steady flow; isentropic flow; stagnation and critical conditions; area-Mach number relation; mass flow rate; normal shocks; convergent nozzle; convergent-divergent nozzle (13 hours).* *Two-dimensional gas dynamics. Oblique shocks and Prandtl-Meyer expansion waves; Mach angle; oblique shock equations; --Mach diagram; shock polar; shock reflection from a solid boundary; pressure-deflection diagrams; intersection of shocks of opposite families and of the same family; detached shock in front of a blunt body; isentropic expansions and compressions; Prandtl-Meyer function; reflection from a free boundary; over-expanded and under-expanded nozzle flows; Shock-Expansion Theory, Thin-Airfoil Theory (13 hours).* *Linearized potential flow. Equations of the velocity potential; linear equation of the perturbed velocity potential; linearized two-dimensional subsonic flow; compressibility correction; critical Mach number (6 hours).* *Aerodynamics. Kutta condition; Kelvin's and Helmholtz's theorems; two-dimensional potential flows. Flow past airfoils of arbitrary shape and evaluation of the force coefficients; finite wing theory and Prandtl's Classical Lifting-Line Theory; applications (13 hours).*
REFERENCE TEXT BOOKS	*John D. Anderson Jr., "Modern compressible flow: With historical perspective", Mc-Graw-Hill, Int. Ed. 1990.* *John D. Anderson Jr., "Fundamental of Aerodynamics", Mc-Graw-Hill, 5th Ed. 2010.*