AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

Insegnamento AERODYNAMICS (MOD.1) C.I.

GenCod A005137

Docente titolare Mario DI RENZO

Insegnamento AERODYNAMICS (MOD.1) C.I.

Insegnamento in inglese AERODYNAMICS (MOD.1) C.I.

Settore disciplinare ING-IND/06

Corso di studi di riferimento AEROSPACE ENGINEERING

Tipo corso di studi Laurea Magistrale

Crediti 6.0

Ripartizione oraria Ore Attività frontale: 54.0

Per immatricolati nel 2022/2023

Erogato nel 2022/2023

Anno di corso 1

Lingua

Percorso Percorso comune

Sede Brindisi

Periodo

Tipo esame Orale

Valutazione

Orario dell'insegnamento https://easyroom.unisalento.it/Orario

BREVE DESCRIZIONE DEL CORSO	The course aims at providing future aerospace engineers with basic knowledge of aerodynamics. The syllabus can be organized into two main parts. The first part discusses the basic theory of one-dimensional and two-dimensional gas dynamics. Both steady and unsteady gas dynamics theory will be discussed while analyzing fundamental flows like de Laval nozzle, Fanno's flow, and Rayleigh's flow. The interactions of supersonic flows with airfoils will also be described using the shock-expansion theory and the thin airfoil theory. The second part of the course deals with the description of irrotational flows. The potential flow theory will be presented and applied to canonical flows using the conformal mapping technique. The theory for linearized flows will be derived with particular attention to linearized compressible
PREREQUISITI	Knowledge of calculus (derivatives and integrals), algebra (basic vector and tensor operations), dynamics of a rigid body, thermodynamics, and fluid dynamics (properties of a fluid, substantial derivative, Reynolds transport theorem, conservation equation of mass, momentum, and energy).
OBIETTIVI FORMATIVI	At the end of this course, students in aerospace engineers should have a good knowledge of: - one-dimensional unsteady as well as two-dimensional steady gas dynamics; - basic principles of two-dimensional potential flow theory; - principles of linearized flow theory in subsonic as well as supersonic regimes.
METODI DIDATTICI	54 hours of lecture
MODALITA' D'ESAME	An oral exam consisting of three questions.

PROGRAMMA ESTESO

- Recap of basic knowledge: conservation equation for a fluid, fluid properties (5 hours)
- Steady quasi-one-dimensional flow: general properties of quasi flows, total and critical quantities, area-velocity relation, mass flux, shock waves and Rankine–Hugoniot relations, convergent nozzles, convergent-divergent nozzles (7 hours)
- Steady non-isentropic one-dimensional flows: adiabatic flow with friction, flow with friction and heat exchange, Rayleigh's flow (4 hours)
- Two-dimensional gas dynamics: oblique shocks, Prandtl-Meyer expansions, shock polars, interactions between different waves, bow shocks, isentropic compressions and expansions, flow past a convergent-divergent nozzle, shock-expansion theory, thin-airfoil theory (9 hours)
- Potential flow theory: Kelvin and Helmholtz theorems, irrotational acyclic and cyclic flows, analytic functions of complex variables, two-dimensional potential flows (uniform flow; source/sink; vortex, doublet), superposition of simple flows, conformal mapping, potential flow past a Joukowski airfoil (6 hours).
- Linearized flow theory: Linearized potential flow equations, linearized pressure coefficient, linear two-dimensional subsonic flow, compressibility corrections, critical Mach number, linear supersonic two-dimensional flow (10 hours)
- Flow over airfoils: airfoil nomenclature and characteristics, Thin airfoil theory (symmetric and cambered airfoil case), Vortex Panel Numerical Method (8 hours)
- Flow over finite wings: downwash and induced drag, Vortex filament, Prandtl's Lifting-Line Theory, Numerical non-linear lifting line method (5 hours)

TESTI DI RIFERIMENTO

Anderson, John David. **Fundamentals of Aerodynamics.** Fifth edition. McGraw-Hill, 2010.
Anderson, John David. **Modern compressible flow: with historical perspective.** Fourth edition. McGraw-Hill, 2020.