

# AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

## Insegnamento AERODYNAMICS (MOD.1) C.I.

GenCod A005137

Docente titolare Giuseppe PASCAZIO

**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** 2020/2021

**Erogato nel** 2020/2021

**Anno di corso** 1

**Lingua**

**Percorso** Percorso comune

**Sede** Brindisi

**Periodo** Secondo Semestre

**Tipo esame** Orale

**Valutazione**

**Orario dell'insegnamento**

<https://easyroom.unisalento.it/Orario>

### BREVE DESCRIZIONE DEL CORSO

*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.*

### PREREQUISITI

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

### OBIETTIVI FORMATIVI

*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.*

### METODI DIDATTICI

*Lectures supported by the use of a computer and a projector*

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## MODALITA' D'ESAME

*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.*

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## PROGRAMMA ESTESO

*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. Quasi 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;  $\gamma$ -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).*

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## TESTI DI RIFERIMENTO

*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.*

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