AEROSPACE ENGINEERING (LM52R)

(Brindisi - Università degli Studi)

Teaching AERONAUTIC PROPULSION MOD. 1

GenCod A003309

Owner professor Maria Grazia DE GIORGI

Teaching in italian AERONAUTIC PROPULSION MOD. 1 C.I.

Teaching AERONAUTIC PROPULSION MOD. 1

SSD code IIND-01/G

Reference course AEROSPACE ENGINEERING

Course type Laurea Magistrale

Credits 6.0

Teaching hours Front activity hours: 54.0

For enrolled in 2026/2027

Taught in 2026/2027

Course year 1

Language

Curriculum AERONAUTICS DESIGN

Location Brindisi

Semester Second Semester

Exam type

Assessment

Open **Course timetable**

BRIEF COURSE DESCRIPTION	This course offers a comprehensive overview of airbreathing engine technologies used in aircraft. It covers a wide array of topics including different types of engines, thermodynamics, flow dynamics in inlets, turbomachinery, combustors, and nozzles. The course also examines piston engines and explores novel propulsion architectures like electric and hybrid systems. Designed for both students and professionals, the course combines theoretical learning with practical insights to enhance understanding of aircraft propulsion requirements, engine performance, and emerging technologies. This curriculum prepares participants for advanced roles in aerospace engineering and development.
REQUIREMENTS	-Fluid dynamic and fluid machinery
COURSE AIMS	1 Gain knowledge of different types of aero-engines (turbojets, turbofans, ramjets) and to understand the aerodynamic and thermodynamic characteristics of major engine components. 2 Develop the knowledge and skills to analytically and numerically solve problems related to aerospace propulsion systems. 3 Develop skills in working independently. 4 Develop skills in critical evaluation of scientific literature. 5 Develop skills in planning and presentation of scientific talks and reports.
TEACHING METHODOLOGY	Theory and practical activities (Tutorials devoted to discussion and problem solving referred to the aeroengine.)
ASSESSMENT TYPE	The final exam consist of two part: 1)Written and oral examination covering all material covered in course 2)assignments and individual project

OTHER USEFUL INFORMATION	Educational materials, resources, and additional information are available on the official course webpage at https://elearning.unisalento.it/

FULL SYLLABUS

- AERONAUTIC PROPULSION – Course Contents
- **Types of Airbreathing Engines and Aircraft Propulsion Requirements**: This introductory module presents the main types of aircraft propulsion systems, including turbojets, turbofans, turboprops and ramjets. It introduces aircraft propulsion requirements in relation to thrust and power generation, mission performance, efficiency, fuel consumption and environmental impact, providing the background for the analysis of both conventional and innovative propulsion systems.
- **Elements of Thermodynamics for Aero-Propulsion & Engine Cycle Analysis**: This module introduces the fundamental thermodynamic principles relevant to aerospace propulsion. Ideal and real engine cycles are analysed, with emphasis on parametric cycle analysis, component efficiencies, specific thrust, specific fuel consumption and overall engine performance. The module provides the thermodynamic basis for the subsequent comparison of conventional, hybrid, electric and alternative propulsion architectures.
- **Flow Dynamics in Subsonic & Supersonic Inlets**: Focuses on the fluid dynamics, design and performance of engine inlets for subsonic and supersonic aircraft. Topics include pressure recovery, flow distortion, shock-wave effects, inlet-engine matching and their impact on engine operability, efficiency and overall propulsion-system performance.
- **Turbomachinery: Axial Flow Compressors and Axial Flow Turbines**: Provides a detailed analysis of axial compressors and turbines, including operating principles, velocity triangles, aerodynamic and thermodynamic performance, characteristic maps and component matching. Particular attention is devoted to the interaction between turbomachinery components and their influence on engine efficiency and off-design operation.
- **Combustors and Sustainable Aviation Fuels**: Covers the operating principles, configurations and design of aero-engine combustors, including combustion stability, efficiency, operability and pollutant emissions. The module introduces **Sustainable Aviation Fuels (SAF)**, their role in aviation decarbonisation, main feedstocks and fuel properties, and analyses their effects on combustor behaviour, emissions, engine operability and fuel efficiency at both engine and mission level. Questi contenuti riprendono direttamente la learning unit sui SAF prevista nel PDF.
- **Nozzles and Exhaust Systems**: Discusses convergent, divergent and convergent-divergent nozzles and their role in converting the thermodynamic energy of the flow into kinetic energy and thrust. Nozzle performance, choked-flow conditions, off-design behaviour and interactions with overall engine performance are analysed.
- **Airbreathing Engine System Integration, Control and Health Management**: Integrates the individual engine components within a system-level framework, addressing engine-aircraft matching, operating envelopes, mission requirements, propulsion control and system integration. The module introduces airworthiness, engine monitoring, diagnostics and **Engine Health Management**, providing an integrated perspective on performance, reliability, maintenance and propulsion-system operation.
- **Propulsion Systems Based on Piston Engines for Urban Air Mobility**: Covers the principles and operation of aircraft piston engines, including the main mechanical components and naturally aspirated and supercharged configurations. The module is extended to propulsion architectures for air mobility, including electrochemical accumulators, inverters, electric motors and gearboxes, hybrid thermal/electric powertrains and experimental techniques for propulsion-system testing. Questa impostazione segue la learning unit specifica presente nel PDF.
- **PROPULSION SYSTEMS NEW CONCEPTS**: Explores advanced and emerging aircraft propulsion technologies, including **hybrid propulsion, electric propulsion, more-electric engines and aircraft, propulsion control, airworthiness and Engine Health Management**. The module introduces the system-level analysis and preliminary design of innovative propulsion architectures, considering aircraft mission requirements, energy management, system integration, efficiency, environmental impact and technological constraints.

Within this module, specific attention is devoted to:

Hydrogen and Fuel Cell Systems for Urban Air Mobility and Autonomous Delivery, including hydrogen fundamentals, production and storage technologies, fuel-cell and battery systems, hybrid-electric architectures, certification, safety, sustainability and infrastructure implications. The module also addresses **Aero-Propulsion for Urban Air Mobility**, including thermal, hybrid and electric aero-powertrains, fuel-cell aero-systems, electric-energy recovery and aeroacoustics/noise-reduction strategies for urban UAVs and eVTOL aircraft.

REFERENCE TEXT BOOKS

- Aerothermodynamics of Gas Turbine and Rocket Propulsion Gordon C. Oates eISBN: 978-1-60086-134-5 print ISBN: 978-1-56347-241-1 DOI: 10.2514/4.861345
- Hill, P., and Peterson, C., Mechanics and Thermodynamics of Propulsion, Addison-Wesley Publishing Co., 1992,
- Course notes