AEROSPACE ENGINEERING (LM52)
(Brindisi - Università degli Studi)

**Insegnamento AIRCRAFT POWERPLANT NEW CONCEPTS, CONTROL AND MAINTENANCE C.I.**

GenCod A006483
Docente titolare Antonio FICARELLA

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<th>Insegnamento AIRCRAFT POWERPLANT</th>
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**BREVÉ DESCRIZIONE DEL CORSO**

AIRWORTHINESS AND ENVIRONMENTAL CERTIFICATION; The Design Process; Engine Selection; Parametric Cycle Analysis; Engine Selection: Performance Cycle Analysis; Engine Component Design: Rotating Turbomachinery, Concept, Design Tools; Engine Component Design: Combustion Systems, Concept, Main Burner, Afterburners; Aircraft Engine Controls - Engine Modeling and Simulation; Aircraft Systems.

Software applications for the design of aircraft engines and systems, using softwares as Python, TESPY, Colaboratory, OPENMODELICA, Octave. Engine performance Lab, Engine Monitoring Lab.

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**PREREQUISITI**

**Course Requirements**

Knowledge of the operating principles of fluid machinery and fluid dynamics. Basic elements of design and technology of fluid machines. Knowledge of aircraft propulsion and the basic principles of flight mechanics.
Aims of the course

(knowledge and understanding)
- Specialist knowledge of propulsion, advanced elements of mechanical design of aircraft engines.
- Knowledge of the internal fluid dynamics.
- Insights on design and technological features and performance of different types of engines.
- Insights into automatic controls and system design aimed at providing an integrated view of the aerospace product.
- Knowledge of advanced propulsion systems.
- Knowledge of specific technical terms in English.

(applying knowledge and understanding)
- Understanding of the main features of a project of the engine.
- Ability to perform sketches and preliminary dimensioning of the components of an aircraft engine.
- Ability to take action in the main stages the project of an aircraft engine.
- Advanced capabilities for the analysis of systems and control techniques.
- Ability to see the product in the form of system integrated complex.

(making judgements)
- Ability to analyze the mission requirements of the aircraft and to evaluate the necessary engine performance.
- Ability to understand the technological issues and system integration for the engine.
- Ability to understand the problems of research and development of an aircraft engine or of an aviation system.

(communication skills)
- Ability to communicate with experts in other fields of engineering for the integrated design of the engine.

(learning skills)
- Development of learning skills that enable to continue to study for the most part autonomously.
- Availability update the acquired knowledge.

OBIETTIVI FORMATIVI

Lectures; practical experiences in laboratories; homework (design project).

Laboratory
Engine performance Lab, Engine Monitoring Lab.
https://sites.google.com/site/greenenginelab2/home

Homework (desig project)
Software applications for the design of aircraft engines and systems, using softwares as Python, TESPY, Colaboratory, OPENMODELICA, Octave. Application examples and design of aircraft engines and systems. Turbofan, turbofans with high bypass ratio, turboprop propeller design. Systems for Civil and military aircraft, helicopters, light aircraft. Fluid-dynamics numerical simulations applied to engines and systems design.
http://www.aircraftenginedesign.com/index.html (free software)
http://www.aircraftenginedesign.com/custom3.html
http://www.grc.nasa.gov/WWW/K-12/freesoftware_page.htm
http://www.cfdsupport.com/openfoam-for-windows.html
**Exam procedures**

The exam consists in the preparation of a Homework (design project) and an oral interview (even remotely carried out).

A design project related to aircraft engines or systems will be conducted. Homework assignments will be due at least one month before the examination. The deliverables are a written report (in digital format, with any files used for calculations and the relevant bibliography) and the discussion of the work. You must acknowledge all references (both literature and people) used; all the deliverables will be sent by email to the instructor at least 10 days before the oral examination. The oral examination consists of the discussion of the work of the year and a series of questions on the matters stated in the course program for the evaluation of acquired knowledge on the principles of operation of engines and aircraft systems, their performance and the principles of design and in general on the technologies of these systems.

**OTHER REFERENCES**

- An Introduction to Combustion, McGrawHill.
- PPSG Volume 1 - Piston Engines & Supercharging, [http://shop.pilotwarehouse.co.uk/product222023catno0.html](http://shop.pilotwarehouse.co.uk/product222023catno0.html).

**INTERNET RESOURCES**

- [http://www.aircraftenginedesign.com/custom2.html](http://www.aircraftenginedesign.com/custom2.html)
ADVANCED PROPULSION CONCEPTS
Hybrid propulsion, electric propulsion, more electrical engine and aircraft.

INTRANET:
OK01-25-TVF2018-Danis-ESaero-Jan191
OK02-3-hybrid-power-in-light-aircraft
OK03-Rodger-Dyson-NASA-Hybrid-Electric-Aircraft-Propulsion-10-4-2017-FULL
OK04-2bfa6572afc09ad13008ca74cefd0a9b130
OK05-EASN2018_DONATEO
Aircraft Reciprocating Engines

FLUID MECHANICAL DESIGN OF AIRCRAFT ENGINE TURBOMACHINERY
The Design Process.
Aircraft Engine Design, cap. 1.
propDESIGNPRO2
for further study:
Propulsion Technologies for Future Commercial Aircraft
Combustion for aerospace
Constraint Analysis.
Mission Analysis.
Aircraft Engine Design, cap. 2 (no par. 2.2.2, 2.2.3, 2.2.4, 2.2.6, 2.2.7, 2.2.8, 2.2.9, 2.2.10, 2.2.11, 2.2.12).
Aircraft Engine Design, cap. 3 (no par. 3.2.1, 3.2.2, 3.2.3, 3.2.6, 3.2.7, 3.2.8, 3.2.9, 3.2.10, 3.2.11).
propCONSTRAINTRA01
propMISSIONRO2
propEXAMPLE-CONSTRAINTR00
for in-depth analysis:
constraintSTRALCIO2
constraintEXAMPLESTRALCIO
missionSTRALCIO
missionEXAMPLESTRALCIO
Aircraft Engine Efficiency and Thrust Measures.
Aircraft Engine Design, app. E.
propMEASURESR02
Engine Selection: Parametric Cycle Analysis.
Engine Selection: Performance Cycle Analysis.
Sizing the Engine: Installed Performance.
Aircraft Engine Design, cap. 4 (for 4.2.3, 4.2.4, 4.2.7 only concepts, no 4.3.4, 4.4 only concepts).
Aircraft Engine Design, cap. 5 (5.2.4, 5.2.5, 5.4 only concepts).
Aircraft Engine Design, cap. 6 (6.2.2, 6.3, 6.4 only concepts).
propPARAMETRICR03
propPERFORMANCER03
propINSTALLEDRO3
propEXAMPLE-PARAMETRICR00

Aircraft Engine Design, cap. 7.
propENGINEDESGNRO3

Aircraft Engine Design, cap. 8.

**DESIGN AND PRODUCTION OF INNOVATIVE TURBOMACHINERY**

Material Properties.

SUPERALLOYS FOR TURBINES and MANUFACTURING METHODS.

Aircraft Engine Design, app. M.

Turbo-Machinery Dynamics, chap. 11, 12.

Turbo-Machinery Dynamics, chap. 6. (no 6.12, 6.18)

Fan and Compressor Airfoils.

Turbine Blade and Vane.

Turbo-Machinery Dynamics, chap. 8.

Fan and Compressor Airfoils.

Turbine Blade and Vane.

Turbo-Machinery Dynamics, chap. 11, 12.

Turbomachinery_DynamicsCh11, Turbomachinery_DynamicsCh12.

Additive manufacturing.

INTRANET:

OK01-Whitis
OK02-Aerospace_Broschuere_WEB_en

**AIRWORTHINESS AND ENGINE HEALTH MANAGEMENT**

Turbine Engine Life Management.

Aircraft Engine Design, app. N.

Engine Monitoring and Health Management, Integrated Control and Health Monitoring.

Aircraft Engine Controls, chap. 8.

INTRANET:

OK01-EASN_2018_R06

**ENGINE CONTROL**

Engine Control Systems.

Aircraft Systems: Mechanical,

Electrical and Avionics Subsystems
Integration, Chap. 2.
Aircraft Engine Design, app. 0.
The Jet Engine (Rolls Royce), cap. 2.6.
Aircraft Engine Controls.
- Engine Modeling and Simulation.

Aircraft Engine Controls, chap. 2.
for in-depth analysis:
AIRCRAFT ENGINE CONTROLSch02
AIRCRAFT ENGINE CONTROLSapp
Design of Set-Point Controllers. Design of Transient and Limit Controllers.
Aircraft Engine Controls, chap. 4, chap. 5.
for in-depth analysis:
AIRCRAFT ENGINE CONTROLSch04
AIRCRAFT ENGINE CONTROLSch05
Advanced Control Concepts.
Aircraft Engine Controls, chap. 7.
for in-depth analysis:
COMBUSTION
Aircraft Engine Design, cap. 9 (no par. 9.1.4.5, 9.1.5.4, 9.3).
THE NEW FRONTIERS FOR THE CONTROL-FICARELLAslidesR31
for in-depth analysis:
Combustion system.
Turbo-Machinery Dynamics, chap. 9.
propTMDcombsysR00
TESTI DI RIFERIMENTO

COURSE BOOKS


Contact the instructor (antonio.ficarella@unisalento.it) for more lecture notes.