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

Insegnamento AIRCRAFT POWERPLANT DESIGN CONTROL AND MAINTENANCE C.I.

GenCod A006156
Docente titolare Antonio FICARELLA

Insegnamento AIRCRAFT POWERPLANT DESIGN CONTROL AND MAINTENANCE Anno di corso 2
Insegnamento in inglese AIRCRAFT POWERPLANT DESIGN CONTROL AND Lingua
Settore disciplinare ING-IND/09 Percorso Percorso comune

Corso di studi di riferimento AEROSPACE ENGINEERING Sede Brindisi
Tipo corso di studi Laurea Magistrale Periodo Primo Semestre

Crediti 9.0 Tipo esame Orale
Ripartizione oraria Ore Attività frontale: Valutazione
81.0
Per immatricolati nel 2020/2021
Erogato nel 2021/2022

ORARIO dell’insegnamento
https://easyroom.unisalento.it/Orario

BREVE DESCRIZIONE DEL CORSO

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.

METODI DIDATTICI

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

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

**Homework (design project)**
Software applications for the design of aircraft engines and systems. Application examples and design of aircraft engines and systems. Turbofan, turbfans 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.

**INTERNET RESOURCES**

[http://www.aircraftenginedesign.com/custom2.html](http://www.aircraftenginedesign.com/custom2.html)
FLUID MECHANICAL DESIGN OF AIRCRAFT ENGINE TURBOMACHINERY

Turbomachinery flow physics
Turbomachinery losses, Efficiencies, Blades
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
propMISSIONR02
propEXAMPLE-CONSTRAINTRA00

for in-depth analysis:
constraintSTRALCIO2
constraintEXAMPLESTRALCIO
missionSTRALCIO
missionEXAMPLESTRALCIO

Aircraft Engine Efficiency and Thrust Measures.

Aircraft Engine Design, app. E.
propMEASURESRO2

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
propPERFORMANCECER03
propINSTALLEDRO3
propEXAMPLE-PARAMETRICR00


Aircraft Engine Design, cap. 7.
propENGINEDESIGNRO3


Aircraft Engine Design, cap. 8.
propROTATINGRO8

COMBUSTION


Aircraft Engine Design, cap. 9 (no par. 9.1.4.5, 9.1.5.4, 9.3).

propCOMBUSTIONRO5
propCOMBUSTIONEXAMPLER02

THE NEW FRONTIERS FOR THE CONTROL-FICARELLAAslidesR31

for in-depth analysis:
propCOMBUSTIONEXAMPLESR02

Some important chemical mechanisms, Pollutant emissions.

Combustion Physics, cap. 3. (no 3.10, 3.11, 3.12)
Droplet evaporation and burning.
*Combustion Physics*, cap. 13. (no 13.4.3, 13.4.4, 13.8, 13.9)

Introduction to turbulent flow, Turbulent premixed flames, Turbulent non-premixed flames.
*Combustion Physics*, cap. 11.

**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.

Fan and Compressor Airfoils.

Turbine Blade and Vane.

Turbomachinery __DynamicsCh11__, Turbomachinery __DynamicsCh12__.

Additive manufacturing.

INTRANET:

OK01-Whitis

OK02-Aerospace_Broschuere_WEB_en

Combustion system.

Turbo-Machinery Dynamics, chap. 9.

**ENGINE CONTROL**

Engine Control Systems.

Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Chap. 2.

Aircraft Engine Design, app. O.

The Jet Engine (Rolls Royce), cap. 2.6.

Aircraft Engine Controls. - Engine Modeling and Simulation.

Aircraft Engine Controls, chap. 2.
AIRCRAFT ENGINE CONTROLS
Design of Set-Point Controllers. Design of Transient and Limit Controllers.
_Aircraft Engine Controls, chap. 4, chap. 5._
propAECdesignspcR02
propAECTransientlR01
_for in-depth analysis:_
AIRCRAFT ENGINE CONTROLSch04
AIRCRAFT ENGINE CONTROLSch05
Advanced Control Concepts.
_Aircraft Engine Controls, chap. 7._
propAECadvancedR00

AIRWORTHINESS AND ENGINE HEALTH MANAGEMENT
Turbine Engine Life Management.
_Aircraft Engine Design, app. N._
propLIFEMANR01
Engine Monitoring and Health Management, Integrated Control and Health Monitoring.
_Aircraft Engine Controls, chap. 8._
propAECmonitoringR01

INTRANET:
OK01-EASN_2018_R06

AIRWORTHINESS AND ENVIRONMENTAL CERTIFICATION
- Aircraft Certification and Production Standards.
- Type Certificates.
- Rules for Initial Airworthiness.
- Certification Specification (CS).
INTRANET:
OK01-General publications _ EASA
OK02-Easy Access Rules for Engines (CS-E) (Amendment 4)
OK03-EASA IM.E.126 EASA TCDS issue 04_20150803_1.0
OK04-EASA E.001_TCDS_issue 09_20150708_1.0
OK05-217487_EASA_EPAS_2018
OK06-documentiR00

ADVANCED PROPULSION CONCEPTS
Aircraft Reciprocating Engines
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
OK04-2bfa6572af09ad13008ca74cefd0a9b130
OK05-EASN2018_DONATEO
COURSE BOOKS
Contact the instructor (antonio.ficarella@unisalento.it) for more lecture notes.