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

Teaching AIRCRAFT POWERPLANT DESIGN AND MAINTENANCE

GenCod A005140
Owner professor Antonio FICARELLA

Teaching in italian AIRCRAFT POWERPLANT DESIGN AND MAINTENANCE
SSD code ING-IND/09

Reference course AEROSPACE ENGINEERING
Course type Laurea Magistrale
Credits 9.0
Teaching hours Ore-Attivita-frontale: 81.0
For enrolled in 2018/2019
Taught in 2019/2020

Course year 2
Language INGLESE
Curriculum PERCORSO COMUNE
Location Brindisi
Semester Primo-Semestre
Exam type Orale
Assessment Voto-Finale
Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

REQUIREMENTS
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.
COURSE AIMS

**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.

TEACHING METHODOLOGY

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, 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. 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 USEFUL INFORMATION

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

INTERNET RESOURCES
http://www.aircraftengineview.com/index.html
http://www.aircraftengineview.com/custom2.html
TOPIC: AIRWORTHINESS AND ENVIRONMENTAL CERTIFICATION, Aircraft Certification and Production Standards, Type Certificates, Rules for Initial Airworthiness, Certification Specification (CS); COURSE BOOK: ; LECTURE NOTES: propDESIGNPR02.


TOPIC: Constraint Analysis, Mission Analysis; COURSE BOOK: 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); LECTURE NOTES: propCONSTRAINTTRA01, propMISSIONR02, propEXAMPLE-CONSTRAINTR00, for in-depth analysis: constraintSTRALCIO2, constraintEXAMPLESTRALCIO, missionSTRALCIO.


TOPIC: Engine Selection: Parametric Cycle Analysis, Engine Selection: Performance Cycle Analysis, Sizing the Engine: Installed Performance; COURSE BOOK: 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); LECTURE NOTES: propPARAMETRICR03, propPERFORMANCE R03, propINSTALLED R03, propEXAMPLE-PARAMETRIC R00.


TOPIC: Material Properties. SUPERALLOYS FOR TURBINES and MANUFACTURING METHODS; COURSE BOOK: Aircraft Engine Design, app. M, Turbo-Machinery Dynamics, chap. 11, 12; LECTURE NOTES: propMATERIALR01, propTMDSuperalloysRO0, propTMDmanufacturingR00, for in-depth analysis: Turbomachinery_DynamicsCh11, Turbomachinery_DynamicsCh12.


TOPIC: Fan and Compressor Airfoils, Turbine Blade and Vane; COURSE BOOK: Turbo-Machinery Dynamics, chap. 6. (no 6.12, 6.18). Turbo-Machinery Dynamics, chap. 8; LECTURE NOTES: propTMDFecairfoilsR01, propTMDturbinevR00, for in-depth analysis: Turbomachinery_DynamicsCh06, propTMDimpellerbrR01, Turbomachinery_DynamicsCh08.

TOPIC: Engine Component Design: Combustion Systems. Concept, Main Burner, Afterburners; COURSE BOOK: Aircraft Engine Design, cap. 9 (no par. 9.1.4.5, 9.1.5.4, 9.3); LECTURE NOTES: propCOMBUSTIONR05, propCOMBUSTIONEXAMPLER02, THE NEW FRONTIERS FOR THE CONTROL-FICARELLAslidesR31, for in-depth analysis: propCOMBUSTIONEXAMPLER02.

TOPIC: Combustion system; COURSE BOOK: Turbo-Machinery Dynamics, chap. 9; LECTURE NOTES: propTMDcombsysR00.

TOPIC: Engine Control Systems; COURSE BOOK: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Chap. 2; LECTURE NOTES: propASEngineContr R00.

TOPIC: Engine Controls.; COURSE BOOK: Aircraft Engine Design, app. O; LECTURE NOTES: propCONTROLRO0.

TOPIC: Aircraft Engine Controls - Engine Modeling and Simulation; COURSE BOOK: Aircraft Engine Controls, chap. 2; LECTURE NOTES: propAEcmodelingR03, for in-depth analysis: AIRCRAFT ENGINE CONTROLSch02, AIRCRAFT ENGINE CONTROLSap.

TOPIC: Design of Set-Point Controllers. Design of Transient and Limit Controllers; COURSE BOOK: ; LECTURE NOTES: propAEcesignspcR02, propAEc transientR01, for in-depth analysis: AIRCRAFT ENGINE CONTROLSch04, AIRCRAFT ENGINE CONTROLSch05.

TOPIC: Advanced Control Concepts; COURSE BOOK: Aircraft Engine Controls, chap. B; LECTURE
NOTES: propAECadvancedR00.

TOPIC: Engine Monitoring and Health Management, Integrated Control and Health Monitoring; COURSE BOOK: Aircraft Engine Controls, chap. 9; LECTURE NOTES: propAECmonitoringR01.

TOPIC: Aircraft Fuel Systems, Fuel System Design Drivers, Fuel System Functions of Commercial Aircraft; COURSE BOOK: AIRCRAFT FUEL SYSTEMS cap. 2 - 3 (no 3.5) - 4; LECTURE NOTES: propAFuelSfueldesignR00, propAFuelSfuelstorageR01, propAFuelSfuelfunctionsR01, AFUELSYSTEMSch020304.

TOPIC: Hydraulic Systems, Electrical Systems, Pneumatic Systems, Environmental Control Systems; COURSE BOOK: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Chap. 4, 5, 6, 7; LECTURE NOTES: propAShydraulicR00, propASpneumaticR01, propASEnvironmentalR00, propASElectricalR00.

TOPIC: Advanced Systems; COURSE BOOK: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Chap. 10; LECTURE NOTES: propASadvancedR00.

TOPIC: System Design and Development; COURSE BOOK: Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Chap. 11; LECTURE NOTES: propASdesignR00.

REFERENCE TEXT BOOKS

COURSE BOOKS


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