# AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

## Teaching HYBRID ELECTRIC AIRCRAFT

GenCod A004328

**Owner professor** Teresa DONATEO

**Teaching in italian** HYBRID ELECTRIC AIRCRAFT

**Teaching** HYBRID ELECTRIC AIRCRAFT

**SSD code** ING-IND/08

**Reference course** AEROSPACE ENGINEERING

**Course type** Laurea Magistrale

**Credits** 9.0

**Teaching hours** Front activity hours: 81.0

**For enrolled in** 2016/2017

**Taught in** 2017/2018

**Course year** 2

**Language** ENGLISH

**Curriculum** PERCORSO COMUNE

**Location** Brindisi

**Semester** Second Semester

**Exam type** Oral

**Assessment** Final grade

**Course timetable** https://easyroom.unisalento.it/Orario

| | |
|---|---|
| BRIEF COURSE DESCRIPTION | Conventional and advanced propulsion systems for aircraft |
| REQUIREMENTS | Sufficiency in flight mechanics and aerospace propulsion. Knowledge of working principles and thermo-fluidodynamic processes of Fluid Machinery and Energy Systems |
| COURSE AIMS | Overview<br>The objectives of the course is to present a unified modeling approach for conventional and advanced aircraft powertrains that takes into account the specifications and the performance of their main components (energy converters, energy storage systems, energy transformes) and the flight mechanic of the aircraft<br><br>Learning Outcomes; after the course the student should be able to<br>*Describe the working principle of propellers and internal combustion engines;<br>*Compare performance and fuel consumption of piston, Wankel and turbine engines in flight and at part load;<br>*Describe and compare conventional and advanced supercharging systems;<br>*Describe the advantages and disadvantages of more electric aircraft, more electric engines, hybrid electric aircraft;<br>* Describe the working principle and compare different technologies of electric machines and electri storage systems;<br>* Simulate and optimize the energy flows in advanced aircraft powertrains. |

| | |
|---|---|
| ASSESSMENT TYPE | written, project work<br>The exam consists of two parts<br>the first part is a written test; the student is asked to illustrate one theoretical topic; it is aimed to verify to what extent the student has gained knowledge and understanding of the selected topic of the course and is able to communicate about his/her understanding;<br>the second part: a project works regarding the simulation and/or optimization of an advanced powertrain; it is aimed to determine to what extent the student has problem solving abilities and the capacity to integrate different concepts and tools. |
| FULL SYLLABUS | Conventional and advanced propulsion systems for aircraft:<br>Turboprop and piston-prop systems. Propeller theory and modeling. More Electric Aircraft. Hybrid electric aircraft. Electric flight: fuel cell systems versus battery-based powertrains (6 hours);<br>Engines for aircraft:<br>Theory and modeling of piston, wankel and gas turbine engines. Effect of load and altitude on the performance of internal combustion engines. Conventional and advanced turbocharging systems. Performance maps of engines and propellers. Willan's line scaling model. (21 hours). Solution to assigned problems with computer based techniques (10 hours).<br>Electric machines:<br>Classifications, performance maps, simplified models. (6 hours)<br>Secondary storage systems:<br>Battery and supercapacitor. Energy and power densities, nominal capacity, life cycles. Simplified models. Other storage systems. (6 hours)<br>Energy management strategies:<br>Charge depleting and charge sustaining. Supervisory controllers for series and parallel hybrid electric power systems. (6 hours)<br>Modeling and optimization of advanced powetrains<br>Backward and forward paradigms. Optimization methods and tools. Evolutionary algorithms for single-objective, multi-objective and many-objective optimization (9 hours). Homework (18 hours). |
| REFERENCE TEXT BOOKS | [1] Handouts (intranet.unisalento.it).<br>[2] Saeed Farokhi, "Aircraft Propulsion", Wiley<br>[3] Guzzella, Sciarretta, "Vehicle Propulsion Systems", Springer<br>[4] Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill<br>[5] Pilot's Handbook of Aeronautical knowledge, chapter 7 (Aircraft Systems) |