# AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

## Teaching AIRCRAFT DESIGN

GenCod A006153

**Owner professor** Giulio AVANZINI

**Teaching in italian** AIRCRAFT DESIGN

**Teaching** AIRCRAFT DESIGN

**SSD code** ING-IND/03

**Reference course** AEROSPACE ENGINEERING

**Course type** Laurea Magistrale

**Credits** 9.0

**Teaching hours** Front activity hours: 81.0

**For enrolled in** 2022/2023

**Taught in** 2023/2024

**Course year** 2

**Language** ENGLISH

**Curriculum** CURRICULUM AEROSPACE DESIGN

**Location** Brindisi

**Semester** Second Semester

**Exam type** Oral

**Assessment** Final grade

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

BRIEF COURSE DESCRIPTION

Aircraft design is on one side a separate discipline in the framework of aeronautical engineering, where specific methods and analysis tools are introduced to size a new aircraft with the objective of developing a vehicle which outperforms existing ones in the same market segment. At the same time, an aircraft designer needs to be well skilled in all the fundamental aeronautical engineering disciplines (aerodynamics, propulsion, structures, systems and – last but not least - flight mechanics), in order to understand and handle all the available options for performing a given set of mission tasks. The course is aimed at introducing the student to this unique mix of specific expertize and multidisciplinary knowledge, challenging him/her with the development of a realistic design for a given set of (possibly competing) mission requirements.

REQUIREMENTS

Good background in Flight Mechanics and Flight Dynamics, Aerospace Structures, Aerodynamics and Aeronautical Propulsion is strongly recommended.

COURSE AIMS

At the end of the course the student is expected to

- understand the relation between aircraft mission and its configuration, in qualitative as well as quantitative terms;
- use this knowledge to perform, at a conceptual level, the preliminary sizing of a fixed wing aircraft as a function of a set of mission and regulatory requirements; draw a sketch by means of some Computer Aided Design tool; estimate performance and update the design, if necessary;
- autonomously perform choices with respect to possible alternatives (e.g. type of engines, cabin layout, wing planform shape and position, etc.);
- present and discuss the resulting design in a report and in oral form, providing adequate motivation for all the choices performed;
- become aware of sources of information related to aircraft design, airworthiness, certification procedures, etc. deriving useful and reliable information for the design process.

## TEACHING METHODOLOGY

The course is delivered with lectures and lab hours.

- **Standard class lectures**: the teacher presents methods and models for fixed wing aircraft conceptual design, spanning a wide range of (mainly civil) missions and configurations; aspects of conceptual design are introduced (preliminary sizing, engine and wing sizing, configuration lofting, performance evaluation, design iterations, cost estimate) at a general level; students are encouraged to participate by discussing design alternatives for each class of aircraft considered, origin of requirements, tradeoffs between competing requirements.
- **Computer lab. classes**: students learn the use of Raymer's Design Software (RDS) for conceptual aircraft design with a "hands on" approach; they are instructed to use the RDS CAD tool and aerodynamic analysis tool.

**Design contest**: each year a design contest is proposed, focused on a particular class of civil aircraft; starting from a set of mission requirements, typical of the considered class, small groups of student (2 or 3) develop throughout the semester their own design, performing aircraft sizing, lofting, performance analysis, thus developing a realistic configuration and solving design tradeoffs between competing mission objective.

At the end of the semester each group presents its own design and a comparison among the resulting design is performed. Cooperation between team members is encouraged, but also information sharing between different groups.

## ASSESSMENT TYPE

The exam is oral.

The exam starts with a discussion of the project work carried out during the semester in order to assess

- the capability of the student in analyzing the considered design example,
- his/her awareness of the various alternatives available for the considered design and
- his/her communication skills in discussing and supporting the choices done.

The oral exam also includes the discussion of more general aspects regarding aircraft design, when applied to different classes of aircraft, in order to assess the student's ability to apply the same concepts to a different scenario.

## FULL SYLLABUS

- Introduction to aircraft design and overview of the design process, from conceptual design through preliminary design to final detail design (6 hours)
- Review of concepts of applied aerodynamics and aircraft configuration (6 hours)
- Sizing from a conceptual sketch with determination of thrustto-weight ratio and wing loading and initial design iterations (6 hours)
- Aircraft layout and lofting by RDS CAD tool (10 hours)
- Propulsion and fuel system integration (4 hours)
- Cost analysis and trade studies (4 hours)
- Lab classes, with supervision and discussion of the design process (18 hours during the semester)

## REFERENCE TEXT BOOKS


- D. P. Raymer, Aircraft Design: a conceptual approach, AIAA Education Series, 2012
- E. Torenbeek, Synthesis of Subsonic Airplane Design: An Introduction to the Preliminary Design of Subsonic General Aviation and Transport Aircraft, with Emphasis on Design, Propulsion and Performance, Springer, 1982
- J. Roskam, Airplane Design (Parts 1 to 8), DAR Corporation, 1985