Aircraft Design

Academic Year: (2023 / 2024) **Review date: 18-04-2023**

Department assigned to the subject: Aerospace Engineering Department

Coordinating teacher: CAVALLARO , RAUNO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Aerodynamics
Flight Mechanics
Aerospace Structures

OBJECTIVES

Applied knowledge of aircraft engineering.
Adequate knowledge applied to engineering of:
- Calculation methods for aircraft design and project;
- Cetification basis and aircraft maintenance;
- Operational use of aircrafts.

Knowledge of concurrent engineering methods and manufacturing processes.
Knowledge of operating environment and aircraft design envelopes.
Knowledge of design variables related to flight and ground performance.
Application of preliminary design methods to establish the main aircraft design variables:
- maximum weight;
- thrust-to-weight ratio;
- wing loading.

Knowledge of methods to determine payload-range diagrams.
Knowledge of aircraft configuration and design constraints for its components: wing, fuselage, tails, etc.
Knowledge of main structural loads conditions, in accordance with certification rules.
Knowledge of specific characteristics of supersonic and fighter aircrafts.

DESCRIPTION OF CONTENTS: PROGRAMME

Preamble.
--> The design process. Phases of aircraft design.
Operational Environment.
--> Systems of units. ISA. Airspeeds. Flight envelopes. Airworthiness.
Cruise Performance.
--> Flight performance. Steady level flight. Range and endurance.
Cruise Optimization.
--> Optimization at fixed altitude. Range optimization within the flight envelope.
Climb Performance.
--> Steady climb. Unsteady climb.
Ground Performance.
--> Take-off analysis. Landing analysis.
Quick Sizing and Design Weights.
--> Quick mass sizing. Mass subdivision. Design weights.
Thrust-to-Weight Ratio and Wing Loading.
--> Definition of T/W and W/S and typical values. Design criteria for T/W and W/S. Drag model. Propulsive model.
Design Weights and Range.
--> Mass subdivision. Design weights. Payload-Range diagram.
Wing Configuration.
--> Wing planform. Wing arrangement. High lift and control surfaces on wing.
Fuselage and Tails Layout
--> Passenger cabin. Fuselage configuration and sizing. General tail layout. HTP and VTP requirements.
Structural Loads.
--> Definitions and envelopes. Balanced NZ conditions. Discrete gusts. General loads conditions.
Combat Aircrafts.

--> Supersonic flight. Fighters configuration and specific design criteria.

LEARNING ACTIVITIES AND METHODOLOGY

Theory sessions.
Problem sessions working individually and in groups.
Practical sessions.

ASSESSMENT SYSTEM

Regular call:
End-of-term exam (60%)
Continuous evaluation (40%)
In order to pass the subject two conditions are required:
1) To obtain a minimum of 5.0/10 in the global mark (End-of-term + continuous evaluation)
2) To obtain a minimum mark of 4.0/10 in the end-of-term exam separately

Extra call:
Only the end-of-term mark is taken into account.
Continuous evaluation is considered in case of improving the mark (under the rules of the regular call).

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- D.P. Raymer Aircraft Design: A Conceptual Approach, AIAA Educational Series, 2012
- E. Torenbeek Synthesis of Subsonic Airplane Design, Springer , 1982
- L.M. Nicolai & G.E. Carichner Fundamentals of Aircraft and Airship Design. Volume I - Aircraft Design, AIAA Education Series, 2010
- L.R. Jenkinson, P. Simpkin, D. Rhodes Civil Jet Aircraft Design, AIAA Education Series, 1999

ADDITIONAL BIBLIOGRAPHY

- A.K. Kundu Aircraft Design. , Cambridge University Press. , 2010
- D. Howe Aircraft Conceptual Design Synthesis, Wiley, 2005
- S.A. Brantdl, R.J. Stiles, J.J. Bertin, R. Whitford Introduction to Aeronautics: A Design Perspective, AIAA Educational Series, 2004