Course guide
220308 - 220308 - Aircraft Propulsion Systems

Last modified: 22/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 5.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Miró Jané, Arnau

Others: Miró Jané, Arnau

PRIOR SKILLS

The student is expected to have a solid knowledge of basic thermodynamics and fluid mechanics. In addition, it is recommended that the student has a minimum knowledge of the Bryton cycle and knows how to perform a parametric analysis of a gas turbine cycle.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CG04-MUEA. (ENG) Capacitat d'integrar sistemes aeroespacials complexos i equips de treball multidisciplinaris.
CE11. MUEA/MASE: An aptitude for designing, building and selecting the most appropriate power plants for aerospace vehicles, including aeroderivative power plants.
CE16. MUEA/MASE: Sufficient knowledge of air-breathing jet engines, gas turbines, rocket engines and turbomachines.
CE17. MUEA/MASE: The ability to carry out the mechanical design of a propulsion system's components.
CE18. MUEA/MASE: The ability to design, execute and analyse propulsion systems tests and carry out the systems' entire certification process.
CE19. MUEA/MASE: Sufficient knowledge of the subsystems of aerospace vehicles' propulsion power plants.

Basic:
CB06. Manage original concepts in research projects.
CB08. Generate decision from incomplete information assuming its social and ethical responsibilities.
CB10. Improve self-learning capacity

TEACHING METHODOLOGY

The classes are divided between theory sessions where the necessary knowledge is developed and practical sessions where the fundamental concepts are discussed through practical examples and/or problems.

LEARNING OBJECTIVES OF THE SUBJECT

Complete propulsion course where the student will learn more about the operation of propulsion systems and their components, applied to multipurpose aircraft. The course aims to reach a level of knowledge that allows students to understand the design parameters and actions of a jet engine regardless of its type. It also seeks to help the student develop an analytical and critical mentality.

The student will begin with a general knowledge of propulsion systems and delve into the design and operation of the engine's turbomachinery. Then it will go into detail in the optimization in the design of the different components that make up the engines, as well as in the actions of the engine when it is in a situation outside of design.

The aim is for the student to gain detailed knowledge of the design cycle of a propulsion system.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	12.00
Self study	80,0	64.00
Hours large group	30,0	24.00

Total learning time: 125 h

CONTENTS

Module 1. Introduction and review of concepts

Description:
Topic 1.1: State of the art of jet engines.
Topic 1.2: Review of thermodynamics and engine design cycle.
Topic 1.3: Alternative engine configurations: turboprop, turboshaft, propfan and open-rotor.

Specific objectives:
The aim of this first module is to provide the student with the necessary tools to carry out the parametric design of jet engines, as well as familiarization with other alternative configurations. The student should be able to draw a block diagram of the engine for further analysis.

Full-or-part-time: 25h
Theory classes: 6h
Laboratory classes: 3h
Self study : 16h

Module 2. Rotating components

Description:
Topic 2.1: Axial compressors
Topic 2.2: Axial turbines

Specific objectives:
The aim of this module is to provide the student with the necessary knowledge to carry out the analysis and parametric calculation of turbomachinery for jet engines. Speed triangles for compressors and turbines are developed as well as the calculation of the thermodynamic cycle and possible simplifications.

Full-or-part-time: 50h
Theory classes: 12h
Laboratory classes: 6h
Self study : 32h

Module 3. Engine design and performance

Description:
Topic 3.1: Considerations in engine design.
Topic 3.2: Analysis of engine components outside the design condition.
Topic 3.3: Off-design analysis.

Specific objectives:
The aim of this module is for the student to develop the necessary knowledge and critical thinking to analyze the design cycle of an engine and to be able to calculate its performances when the engine operates at conditions outside the design point.

Full-or-part-time: 50h
Theory classes: 12h
Laboratory classes: 6h
Self study : 32h

GRADING SYSTEM

N = 0.3 E1 + 0.3 E2 + 0.3 P + 0.1 C

N: Final grade
E1: First partial grade
E2: Second partial grade
Q: Project grade
C: Class grade

Students with a grade below 5.0 will be able to do a recovery exam in order to compensate for the poor results. The new grade will replace the original only if it is higher. The maximum grade that can be obtained with this additional evaluation is 5.0.

EXAMINATION RULES.

During the examinations, students can bring up to two sheets of paper (handwritten or computer generated) with a summary of what has been explained in class at the student's discretion.

BIBLIOGRAPHY

Basic:
- Mattingly, Jack D. Elements of gas turbine propulsion. New York: American Institute of Aeronautics and Astronautics, 2005. ISBN 1563477785.
- Mattingly, Jack D; Heiser, William H; Pratt, David T. Aircraft engine design. 2nd ed. Reston, VA: American Institute of Aeronautics and Astronautics, cop. 2002. ISBN 1563475383.

Complementary:
- Kerrebrock, Jack L. Aircraft engines and gas turbines. 2nd ed. Cambridge, Mass.: MIT Press, cop. 1992. ISBN 0262111624.
- Roskam, Jan. Airplane design. Lawrence: DARcorporation, cop. 1986-2000. ISBN 188488542X.
- Torenbeek, Egbert. Advanced aircraft design: conceptual design, analysis and optimization of subsonic civil airplanes [on line]. West Sussex, England: John Wiley & Sons Ltd., 2013 [Consultation: 26/04/2024]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9781118568101. ISBN 9781118568118.