

Course guide (work version)

300090 - AE_MUEA - Aviation and Environment

Last modified: 03/02/2022

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 748 - FIS - Department of Physics.

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

Academic year: 2021 **ECTS Credits:** 5.0 **Languages:**

LECTURER

Coordinating lecturer: Jovana Kuljanin

Others: Raúl Sáez García

PRIOR SKILLS

English (and professional/technical English). Basic and required courses related to calculus and statistics. Knowledge related to international agreements and organizations in civil aviation and air transport industry in general. Previous concepts include knowledge of air traffic management, air transport infrastructure given in any bachelor's degree in aerospace engineering and reviewed in previous subjects of this Master's degree. Familiarity with knowledge of programming languages is required, specially Python and/or Matlab and C++.

REQUIREMENTS

Concepts seen in 220309 - Transport Aeri i Sistemes de Navegació
(https://www.upc.edu/estudispdf/guia_docent.php?codi=220309&idioma=en)

TEACHING METHODOLOGY

The course combines the following teaching methodologies:

- Theory classes.
- Autonomous learning: students will study using self-learning material.
- Cooperative learning: students will form small groups (2-4 people) to fulfill some of the activities of the course.
- Project based learning: students will build a small team project (3-4 people).

Directed learning hours will consist in exercises and practical examples, after the theory classes in which the professor exposes the content of the subject. With the directed learning hours, the students will be motivated to participate actively in their education and to complete the knowledge acquired during theory classes, usually with the help of computers.

LEARNING OBJECTIVES OF THE SUBJECT

This course addresses environmental challenges such as greenhouses gas emissions and noise in a broader context of sustainable aviation growth. Different types of strategies to mitigate the adverse effects of aviation operations will be examined with special emphasis on the novelty in ATM procedures and operations. Some optimization framework used in the field will be proposed, as well as different ATM performance assessment frameworks. At the end of the course, the student will be able to:

- . understand the general concept and trends in the aviation and its impact on environment;
- . understand different types of externalities generated by aviation activities;
- . identify and quantify different sources of fuel (CO₂) inefficiency by applying different sets of KPAs/KPIs;
- . model and validate how novel air traffic management (ATM) procedures may lead to CO₂ reduction and sustainable growth;

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

Introduction to Sustainability

Description:

- Introduction the general concept of sustainability, important dates and documents related to sustainability.
- The concept of suitability in transport systems (performance indicators, classification of model for sustainability assessment, data required, composite sustainability index (CSI))
- Air transport development and its impact on environment
- National/International Aviation Organization dealing with "greener" air transport

Full-or-part-time: 13h

Theory classes: 4h

Laboratory classes: 3h

Self study : 6h

External negative effects of aviation: CO2 emissions, NOx emissions and noise.

Description:

Overview, description and literature review on:

- Aviation greenhouses gas emissions
- CO2 emissions (calculation, trends, methodologies, policy, market-based measures)
- NOx emissions (calculation, trends, methodologies)
- Different measures towards sustainable aviation (Sustainable Alternative Fuel (SAF), carbon market-based measures, regulations, advancements in aircraft design and technology, modernization of ATM system)
- Noise (calculation, noise charts, IMPACT software, airport noise charges)

Full-or-part-time: 29h

Theory classes: 9h

Laboratory classes: 4h

Self study : 16h

Project I: Post-assessment methodology for measuring fuel (CO2) inefficiency at ECAC area

Description:

Working in groups, the students will analyse fuel inefficiency (CO2 emissions) from different aspects from a list of topics proposed by the lecturer, which will cover different baseline scenarios and objective function specifications. The students will perform a multivariate statistical analysis to address the particular challenge. A report will be delivered and a presentation summarizing the achievement will be given in front of the rest of students.

Full-or-part-time: 31h

Theory classes: 3h

Guided activities: 8h

Self study : 20h



Project II: Advancement in ATM operations and its effect on CO2 reduction

Description:

In order to explore the enhancements in ATM procedures and their implications to CO2 emissions and fuel consumptions, the students will develop an enhanced optimization framework for fully automated scheduling of energy-efficient continuous-descent arrivals with guaranteed separation in the Terminal Maneuvering Area (TMA). The algorithm will be validated on a small-case study. A report will be delivered and a presentation summarizing the achievement will be given in front of the rest of students.

Full-or-part-time: 52h

Theory classes: 3h

Guided activities: 11h

Self study : 38h

GRADING SYSTEM

Participation in class and exercises: 10%

Individual exams and tests: 35%

Projects and presentations: 55%

BIBLIOGRAPHY

Basic:

- Gössling, S., Upham, P., . Climate Change and Aviation: Issues, Challenges and Solutions. London, Sterling, VA: Earthscan, 2009.
- Prats, X., Dalmau, R., Barrado, C.. "Identifying the sources of flight inefficiency from historical aircraft trajectories. a set of distance- and fuel-based performance indicators for post-operational analysis". In Proc. of the 13th USA/Europe Air Traffic Management Research and Development Seminar, 2019..
- Abrantes, I.; Ferreira, A.; Silva, A.;Costa, M. . "Sustainable aviation fuels and imminent technologies - CO2 emissions evolution towards 2050". Journal of Cleaner Production.
- EUROCONTROL. "Flying the 'perfect green flight': How can we make every journey as environmentally friendly as possible?". EUROCONTROL - Aviation Intelligence Unit..
- Lee, D.; Fahey, D.; Forster, P.; Newton, P.; Wit, R.; Lim, L.; Sausen, R. . "Aviation and global climate change in the 21st century". Atmospheric Environment. <https://www.sciencedirect.com/science/article/pii/S1352231009003574>.
- Janić, Milan. Greening Airports [Recurso electrónico] : Advanced Technology and Operations . London : Springer London, 2011. ISBN 978-0-85729-658-0.
- Fankhauser et al.,. "The meaning of net zero and how to get it right". Nature Climate Change.