

Guía docente

300090 - AE_MUEA - Aviación y Medio Ambiente

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Unidad responsable: Escuela de Ingeniería de Telecomunicación y Aeroespacial de Castelldefels

Unidad que imparte: 748 - FIS - Departamento de Física.

Titulación: MÁSTER UNIVERSITARIO EN INGENIERÍA AERONÁUTICA (Plan 2014). (Asignatura optativa).

Curso: 2023

Créditos ECTS: 5.0

Idiomas: Inglés

PROFESORADO

Profesorado responsable: Jovana Kuljanin

Otros: Raúl Sáez García

CAPACIDADES PREVIAS

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++.

REQUISITOS

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

METODOLOGÍAS DOCENTES

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.

OBJETIVOS DE APRENDIZAJE DE LA ASIGNATURA

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;

HORAS TOTALES DE DEDICACIÓN DEL ESTUDIANTE

Tipo	Horas	Porcentaje
Horas grupo grande	45,0	36.00
Horas aprendizaje autónomo	80,0	64.00

Dedicación total: 125 h

CONTENIDOS

Introduction to Sustainability

Descripción:

- 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

Dedicación: 13h

Grupo grande/Teoría: 4h

Grupo pequeño/Laboratorio: 3h

Aprendizaje autónomo: 6h

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

Descripción:

Overview, description and literature review on:

- Aviation greenhouse gas emissions
- CO2 emissions (calculation, trends, methodologies, policy, market-based measures)
- NOx emissions (calculation, trends, methodologies)
- Analysis of historical aviation environment targets and their results.
- 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)

Dedicación: 34h

Grupo grande/Teoría: 12h

Grupo pequeño/Laboratorio: 4h

Aprendizaje autónomo: 18h

Project I: Tools for flight CO2 emissions computation

Descripción:

Flight CO2 emissions will be further analyzed, detailing the contribution of each flight phase (including on ground operations). Practical cases will then be studied using the IMPACT tool from EUROCONTROL.

Dedicación: 26h

Grupo grande/Teoría: 3h

Actividades dirigidas: 3h

Aprendizaje autónomo: 20h

Project II: Research on fuel efficiency indicators and models

Descripción:

The aim of the project is to investigate the different methodologies available nowadays to measure the fuel efficiency of aircraft operations.

Dedicación: 52h

Grupo grande/Teoría: 3h

Actividades dirigidas: 11h

Aprendizaje autónomo: 38h

SISTEMA DE CALIFICACIÓN

Participation in class and exercises: 10%

Individual exams and tests: 35%

Projects and presentations: 55%

BIBLIOGRAFÍA

Básica:

- 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 [en línea]. [Consulta: 11/07/2022]. Disponible a: <https://upcommons.upc.edu/handle/2117/170271>.- Abrantes, I.; Ferreira, A.; Silva, A.; Costa, M.. "Sustainable aviation fuels and imminent technologies - CO2 emissions evolution towards 2050". Journal of Cleaner Production [en línea]. Volume 313, 1 September 2021, 127937 [Consulta: 11/07/2022]. Disponible a: <https://www.sciencedirect.com/recursos.biblioteca.upc.edu/science/article/pii/S0959652621021557>.- EUROCONTROL. "Flying the 'perfect green flight': How can we make every journey as environmentally friendly as possible?". EUROCONTROL - Aviation Intelligence Unit [en línea]. Disponible a: <https://www.eurocontrol.int/publication/eurocontrol-think-paper-10-flying-perfect-green-flight>.- Gössling, Stefan; Upham, Paul. Climate change and aviation : issues, challenges and solutions. Abindon, Oxon : New York: Earthscan, 2009. ISBN 9781844076192. - 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 [en línea]. Volume 43, Issues 22-23 [Consulta: 11/07/2022]. Disponible a: <https://www.sciencedirect.com/science/article/pii/S1352231009003574>.- Fankhauser et al.,. "The meaning of net zero and how to get it right". Nature Climate Change.