Course guides
300286 - AP - Atmospheric Physics

Last modified: 09/06/2021

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

Degree: MASTER'S DEGREE IN AEROSPACE SCIENCE AND TECHNOLOGY (Syllabus 2021). (Optional subject).

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

LECTURER

Coordinating lecturer: Pino Gonzalez, David

Others:

PRIOR SKILLS

To be able to operate with the concepts and laws of mechanics, thermodynamics and fluid mechanics.

To be able to operate in differential and integral calculus of vector fields.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE4 MAST. (ENG) CE4: Aplicar el método científico para el estudio de la fenomenología particular del ambiente aeroespacial.

Transversal:
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

Basic:
CB6. (ENG) CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación.
CB10. (ENG) CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.
CB7. (ENG) CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.
CB8. (ENG) CB8 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios.
CB9. (ENG) CB9 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades.

TEACHING METHODOLOGY

The contents of the course will be explained by theoretical lessons combining blackboard and slides and practical exercises

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student should be able to:
- To define the fundamental physical variables: pressure, humidity, density, and temperature that drives atmospheric dynamics.
- Identify the different layers of the Earth atmosphere and their main characteristics, the atmospheric composition and atmospheric phenomena in the troposphere.
- Identify the main characteristics of the atmosphere of the different planets and how they affect to space missions.
- Understand the thermal equilibrium, the radiative balance and stability of the atmosphere.
- Understand the origin of the horizontal and vertical movements of the air and how they affect to aviation.
- Understand the importance of water vapour in the atmosphere, its measurement, phase changes, and the formation of fog and clouds, and its influence on aviation.
- Understand the physics of clouds, and to be able to identify the basic types, and associated weather phenomena.

CONTENTS

Introduction

Description:
- Importance of meteorology in aviation and space missions.
- Main variables used to study the atmosphere: temperature, pressure, density, wind speed and direction. Units of measurement.
- Definition, structure and composition of the planetary atmospheres.
- International Standard Atmosphere. The hydrostatic approximation.

Full-or-part-time: 11h
Theory classes: 3h
Self study : 8h

Thermal equlibrium of planetary atmospheres

Description:
- Black bodies: Wien, Stephan-Boltzman equations.
- Solar radiation. Solar constant.
- The greenhouse effect in planetary atmospheres.

Full-or-part-time: 6h
Theory classes: 2h
Self study : 4h

Stability and atmospheric dynamics

Description:
- Stability and vertical movements. Potential temperature.
- Atmospheric boundary layer.
- Turbulence and winds in the atmosphere. Different types of wind depending on their horizontal scale: micro and mesoscale systems.
- Altimeter settings on a plane or airport. Problems and relation with atmospheric pressure and temperature.
- Driving forces. Geostrophic and gradient winds.
- Main isobaric features: cyclones, anticyclone, ridge, trough

Full-or-part-time: 32h
Theory classes: 10h
Guided activities: 2h
Self study : 20h

Water in the Earth atmopshere: humidity, clouds and precipitation

Description:
- Water vapor in the Earth atmosphere: pressure, condensation. Definitions of humidity.
- Stability of the saturated air. Cloud formation.
- Cloud's classification: description, and influence to the flight conditions. Main weather phenomena associated to clouds. Condensation trails.
- Precipitation. Types of precipitation.

Full-or-part-time: 24h
Theory classes: 6h
Guided activities: 2h
Self study : 16h

General circulation and synoptic meteorology

Description:
- Global atmospheric circulation in planetary atmospheres.
- Air masses in the Earth atmosphere: origin and effect on the weather.
- Fronts: types, associated precipitation and flight conditions.

Full-or-part-time: 18h
Theory classes: 4h
Guided activities: 2h
Self study : 12h

Meteorological hazards for aviation

Description:
- Visibility. Causes of atmospheric obscurity. Types of visibility.
- Icing: Definition, formation and types of icing.
- Turbulence at low levels. Definition. Orographic waves, rotors, wind shear.
- CAT
- Thunderstorms and severe weather.
- Climate change and aviation: influence and impacts of climate change on aviation.

Full-or-part-time: 20h
Theory classes: 8h
Self study : 12h

Meteorological information for aviation

Description:
- Observations nad forecaast reports: METAR, SPECI, TAF, SIGMET.
- Significant weather maps at different levels.
- Temperature and wind speed maps.

Full-or-part-time: 18h
Theory classes: 4h
Guided activities: 3h
Self study : 11h

GRADING SYSTEM

It will be defined in the EETAC web page

EXAMINATION RULES.

All the activities to be evaluated are compulsory. Any exam or deliverable not presented on time will be evaluated with a zero mark. All the evaluations are individual

BIBLIOGRAPHY

Basic:
- Ahrens, C. Donald. Meteorology today : an introduction to weather, climate, and the environment. 8th. Pacific Grove, CA: Thomson/Brooks/Cole, 2007. ISBN 9780495011620.
- Joint Aviation Authorities. Meteorology : JAA ATPL training. 2nd. Englewood: Jeppesen Sanderson, 2007. ISBN 0884874885.
- Lankford, Terry T. Aviation weather handbook. New York: McGraw-Hill, 2001. ISBN 0071361030.
- Ledesma Jimeno, Manuel; Baleriola, Gabriel. Meteorología aplicada a la aviación. 12ª. Madrid: International Thomson Paraninfo, 2003. ISBN 8428328404.
- International Civil Aviation Organization. Annexes to the Convention on International Civil Aviation [Recurs electrònic]. Montreal: ICAO, [19??]-. ISBN 9291942405.
- Sánchez-Lavega, Agustín. An Introduction to planetary atmospheres [on line]. Boca Raton: CRC Press/Taylor & Francis Group, cop. 2011 [Consultation: 16/06/2021]. Available on: https://www.taylorfrancis.com/books/9780429184581. ISBN 9781420067323.
- Taylor, F. W. Planetary atmospheres. Oxford: Oxford University Press, 2010. ISBN 9780199547418.

Complementary:
- Stull, Roland B.; Ahrens, C. Donald. Meteorology for scientists and engineers. 2nd. Pacific Grove (Calif.): Brooks/Cole, 2000. ISBN 0534372147.