

## Course guide

### 205240 - AM - Aviation Meteorology

Last modified: 12/07/2021

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

**Degree:** **Academic year:** 2021 **ECTS Credits:** 3.0  
**Languages:** English

#### LECTURER

**Coordinating lecturer:** JUAN PEDRO MELLADO GONZALEZ

**Others:**

#### PRIOR SKILLS

Basic knowledge of thermodynamics and fluid mechanics is required. Basic knowledge of calculus, algebra and mathematical analysis is required.

#### TEACHING METHODOLOGY

Each session consists of a theoretical part and a practical part. In the practical part, a set of small exercises will be solved and discussed in class to fix the main ideas and concepts of the session. The take-home assignments will also be discussed during this practical part, when needed. The course material will be the course slides, audiovisual material, and a small set of simulation and observational data to illustrate the analysis approaches described in the course.

#### LEARNING OBJECTIVES OF THE SUBJECT

This course is an introduction to meteorology and its importance in aerospace science and engineering.

At the end of the course, the student will be able

- to understand the structure and composition of the atmosphere,
- to understand atmospheric thermodynamics and static stability,
- to understand the importance of water in the atmosphere (water vapor, fog and cloud formation, precipitation) and his influence on navigation and surface operations,
- to understand atmospheric dynamics, both horizontal motions (advection, geostrophic wind, gradient wind, thermal winds) and vertical motions (convection, turbulence) and how they affect to navigation,
- to understand the factors and hazards that affect navigation (icing, visibility, turbulence), the prevention tools and risk minimization.

#### STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	40.00
Self study	45,0	60.00

**Total learning time:** 75 h

## CONTENTS

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### Module 1: Introduction, atmospheric composition and structure, energy balance

**Description:**

- Importance of meteorology and climatology in aviation.
- Composition of the atmosphere.
- Vertical structure. Temperature, pressure, density.
- Hydrostatic balance.
- The International Standard Atmosphere.
- Energy transfer.
- Radiative transfer and radiative equilibrium. The greenhouse effect.
- Annual energy balance.

**Full-or-part-time:** 12h 30m

Theory classes: 5h

Self study : 7h 30m

### Module 2: Thermodynamics, static stability and clouds

**Description:**

- Atmospheric thermodynamics.
- Static stability.
- Associated motions: convection and gravity waves.
- Water vapor in the atmosphere. Definitions of humidity.
- Phase change.
- Stability of the saturated air.
- Cloud formation.
- Clouds classification. Cloud base and ceiling. Main weather phenomena associated to clouds.
- Precipitation. Types of precipitation. Influence on aircraft structure and performance. Icing.

**Full-or-part-time:** 18h 45m

Theory classes: 7h 30m

Self study : 11h 15m

### Module 3: Air pressure and local winds

**Description:**

- Air pressure.
- Main isobaric features: cyclones, anticyclone, ridge, trough.
- Altimeter settings on a plane or airport. Problems and relation with atmospheric pressure and temperature.
- Horizontal forces and associated winds: Coriolis force, geostrophic wind, gradient wind, surface wind, thermal wind.
- Scales of motion.
- Local wind systems. Thermal and mechanical circulation.
- Winds related to clouds.
- Turbulence. Wind shear. Clear air turbulence (CAT).
- The atmospheric boundary layer.
- Wind profile near the surface.

**Full-or-part-time:** 18h 45m

Theory classes: 7h 30m

Self study : 11h 15m

### Module 4: General circulation, air masses and fronts

**Description:**

- General circulation.
- Cells, belts, jet stream, Rossby waves. Distribution of areas of low and high pressure. Cyclones and anticyclones.
- Air masses: origin and effect on the weather.
- Fronts: types, associated precipitation and flight conditions.

**Full-or-part-time:** 12h 30m

Theory classes: 5h

Self study : 7h 30m

### Module 5: Aeronautical applications

**Description:**

Meteorological hazards for aviation:

- Visibility. Causes of atmospheric obscurity. Types of visibility: horizontal visibility, slant visibility, prevailing visibility, Runaway Visual Range (RVR).
- Icing: Definition, formation and types of icing.
- Turbulence at low levels. Definition. Orographic waves, rotors, wind shear, CAT.
- Thunderstorms and severe weather.
- Relation of meteorological hazards on flight phases.
- Climate change and aviation: influence and impacts of climate change on aviation.

Meteorological information for aviation:

- Message and local reports: METAR, SPECI, TAF, SIGMET.
- Significant weather maps.

**Full-or-part-time:** 12h 30m

Theory classes: 5h

Self study : 7h 30m

## GRADING SYSTEM

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5 take-home assignments (each assignment contributes 20% to the final grade).

In case of failing, the grade will be based on one additional written in-class exam on the date fixed in the calendar of final exams. The grade obtained in the additional written in-class exam will range between 0 and 10 and will replace that of the course based on the take-home assignments.

## BIBLIOGRAPHY

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### Basic:

- Ahrens, C. Donald. Meteorology today : an introduction to weather, climate and the environment. 8th ed. Pacific Grove, CA: Thomson/Brooks/Cole, cop. 2007. ISBN 9780495011620.
- Lester, Peter F. Aviation weather. Englewood, CO: Jeppesen Sanderson, [2013]. ISBN 9780884875949.
- Federal Aviation Administration. Aviation weather : FAA Advisory Circular, AC 00-6B (FAA Handbooks series) [on line]. Aviation Supplies & Academics Inc, [2016] [Consultation: 25/01/2021]. Available on: [https://www.faa.gov/documentLibrary/media/Advisory\\_Circular/AC\\_00-6B.pdf](https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_00-6B.pdf). ISBN 9781619544437.

### Complementary:

- Stull, Roland B. Meteorology for scientists and engineers. 2nd ed. Pacific Grove, CA: Brooks/Cole, cop. 2000. ISBN 0534372147.
- Wallace, John M.; Hobbs, Peter. Atmospheric science : an introductory survey [on line]. 2nd ed. Burlington, MA: Elsevier Academic Press, cop. 2006 [Consultation: 10/06/2022]. Available on: <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780127329512/atmospheric-science>. ISBN 9780127329512.
- Collins, Richard L. Flying the weather map. 2nd ed. Newcastle: Aviation Supplies & Academics, 1999. ISBN 1560273194.
- Ackerman, Steven A.; Knox, John. Meteorology : understanding the atmosphere. 2nd ed. Pacific Grove, CA: Thomson Learning, cop. 2007. ISBN 0495108928.
- Vilà-Guerau de Arellano, Jordi. Atmospheric boundary layer : integrating air chemistry and land interactions. New York: Cambridge University Press, 2015. ISBN 9781107090941.