

**Navigation and Air Traffic Control Techniques**

Code: 101750  
ECTS Credits: 6

Degree	Type	Year	Semester
2501233 Aeronautical Management	OB	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

### Contact

Name: Xavier Verge Mestre  
Email: Xavier.Verge@uab.cat

### Use of Languages

Principal working language: spanish (spa)  
Some groups entirely in English: No  
Some groups entirely in Catalan: No  
Some groups entirely in Spanish: Yes

### Other comments on languages

Se trabajará habitualmente con el idioma inglés

### Teachers

Enrique Reguilón Oter

### Prerequisites

To be able to assimilate the subject correctly, the knowledge of CNS (Communications, Navigation and Surveillance) given in the "telecommunications in the Aeronautical Sector" subject (second course) is requested.

### Objectives and Contextualisation

This course introduces the student to the world of new technologies for aviation. It is divided into four blocks: Communications, Navigation, Surveillance and Air Traffic Management (ANS). With this basic division in 4 blocks, an analysis of the traditional / current technologies and procedures is carried out, as well as the main technological and procedural developments that are arriving in the process of change that the world of aviation is currently living, along with a prospection based on the key elements that are requested from the future ATM system, which explain many of these changes that are already being lived, and which allow us to predict with some accuracy what will be its evolution in the coming decades.

### Competences

- Communication.
- Identify, develop and maintain the necessary resources to meet the tactical and operative needs inherent to air transport activities.
- Personal attitude.
- Personal work habits.

- Thinking skills.
- Use knowledge of the fundamental principles of mathematics, economics, information technologies and psychology of organisations and work to understand, develop and evaluate the management processes of the different systems in the aeronautical sector.
- Use new technologies in airline management.

## Learning Outcomes

1. Assess the performance of the new ADS-B technology.
2. Communicate knowledge and findings efficiently, both orally and in writing, both in professional situations and with a non-expert audience.
3. Critically assess the work done.
4. Describe new navigation systems.
5. Describe the new aircraft-tower communications: Datalink.
6. Develop critical thought and reasoning.
7. Develop curiosity and creativity.
8. Develop independent learning strategies.
9. Develop the ability to analyse, synthesise and plan ahead.
10. Identify the aeronautical environment.
11. Identify the potential benefits of the new 4D trajectory management.
12. Identify the technological resources necessary for the airside management of operations in the terminal control area.
13. Identify the technology that aircraft must have on board to meet needs of communication, navigation and surveillance.
14. Maintain a proactive and dynamic attitude towards career progression, personal growth and continuous professional development. Have the will to succeed.
15. Make efficient use of ICT in communicating ideas and results.
16. Manage routes in accordance with the new ATFM manual.
17. Manage time and available resources. Work in an organised manner.
18. Understand the new surveillance systems.
19. Use English as the primary language of professional communication.
20. Work independently.

## Content

Contents Theoretical Classes

Theory Block I: FUNDAMENTALS OF AIR NAVIGATION

Unit 1: CONCEPT OF AIR NAVIGATION.

- pre-flight planning
- positioning
- guided
- route concept
- flight plan
- on-board instruments
- types of navigation

Unit 2: CARTOGRAPHY AND GEODESY.

- earth movements and their effects
- time systems
- Earth's magnetic field
- geographic reference systems
- the scale

- cartographic projections
- aeronautical charts
- drift

#### Unit 3: METEOROLOGY.

- the atmosphere
- ISA
- wind
- cloud types
- front areas
- pressure changes
- turbulence, dew point, icing, shear

#### Unit 4: RADIO WAVES.

- basic concepts
- electromagnetic spectrum

#### Unit 5: AIR CIRCULATION.

- general concept
- position reports
- ATC objectives
- international regulations
- national and community legislation
- flight rules
- flight levels

#### Unit 6: AIR SPACES.

- airspace classes
- aerial areas

### Theory II Block: AIR NAVIGATION SYSTEM

#### Unit 7: ANS GENERAL CONCEPTS.

- ultimate goal of air navigation
- regulatory bodies and ANSPs (SES)
- ANS functional areas
- temporary processes

#### Unit 8: COMMUNICATIONS (COM).

- aeronautical fixed service
- aeronautical mobile service
- aeronautical messages
- aeronautical messaging networks
- Aeronautical mobile satellite service
- aeronautical broadcasting service
- aeronautical radionavigation service
- separation of aeronautical frequencies
- CPDLC system

#### Unit 9: NAVIGATION (NAV).

- conventional systems
- satellite systems
- RNAV and RNP concepts
- PBN concept
- GNSS concept
- augmentation systems
- free flying and free route airspace (FRA)

Unit 10: AIR SURVEILLANCE (SOUTH).

- General concepts
- types of radars
- multilateration
- ADS

Unit 11: AERONAUTICAL METEOROLOGY SERVICE (MET).

- weather reports
- decoding messages
- meteorological offices

Unit 12: AERONAUTICAL INFORMATION SERVICE (AIS).

- products and publications
- SWIM concept

Unit 13: SEARCH AND RESCUE (SAR).

- organizational structure
- alert phases

Unit 14: MANAGEMENT OF AIR TRAFFIC (ATM).

Theory III Block: AIR TRAFFIC CONTROL TECHNIQUES

Unit 15: ATM GENERAL CONCEPTS.

- general definition
- main indicators

Unit 16: MANAGEMENT OF AIRSPACE (ASM).

- principles and strategies
- flexible use of airspace (FUA)
- time phases
- CDM concept
- RPAS integration
- U-space concept

Unit 17: MANAGEMENT OF THE AIRFLOW AND CAPACITY OF THE AIRSPACE (ATFCM).

- principles and objectives
- time phases
- regulatory measures
- CFMU
- air delays

Topic 18: AIR TRAFFIC SERVICES (ATS)

- main objectives
- FIC
- ALR
- ATC
- TWR aerodrome control service
- ACC area / route control service
- APP approach control service
- minimum separation by time and distance
- TBS concept
- RVSM concept
- conflict alert systems
- A-CDM airport system
- remote control towers

Topic 19: TRM - HUMAN FACTORS IN ATC

- human interactions

- relationship with CRM
- CISM concept

### Contents Practical Classes

Exercises in simulation environments (ATC and pilot) and other tools to deepen the learning from the experience by the student, especially to better understand the limitations of the technologies and processes of the current ANS system and to identify areas for improvement as well as anticipate which technologies and processes are most likely to evolve in a future ANS system.

### Project Content

Research and critical discussion on the current state of technology and processes studied in class. Specialized work on one of the topics proposed by the teacher and that must be related at a specific level and at a general level with the contents of the subject.

## Methodology

The general methodological approach of the subject is based on the principle of multivariate strategies, so it is intended to facilitate the active participation and the construction of the learning process by the student. In this sense, lectures will be considered in a whole group, practical activities, participatory debates and follow-up processes of the student's work.

In order to develop the subject and seminars, "Power Point" presentations and short videos will be used.

All the subjects are complemented with practical sessions of laboratory. Also distributed to the material students to do the exercises: Aeronautical Letters, Sheets of Loading ...

## Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Sessions of practical problems	15	0.6	3, 1, 18, 4, 5, 8, 9, 7, 6, 17, 12, 10, 13, 14, 20
Theory Classes	30	1.2	1, 18, 4, 5, 8, 9, 6, 16, 12, 10, 13, 11, 20
Type: Supervised			
Seminars	5	0.2	9, 7, 6, 16, 10, 11
Type: Autonomous			
Development research work	30	1.2	3, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 10, 13, 11, 14, 20, 19
Seminars Preparation	20	0.8	3, 2, 8, 9, 7, 6, 15, 17, 14, 20, 19
Study	45.5	1.82	3, 1, 18, 4, 5, 8, 9, 7, 6, 17, 16, 12, 10, 13, 11, 14, 20, 19

## Assessment

According to the UAB Academic Regulations in force, the evaluation process for this subject will consist of:

- A continuous evaluation system.
- A recovery mechanism of the evaluation of the subject

In this subject the continuous assessment grade consists of:

- A theory exam (70%), delivered classroom exercises and practice reports (20%) and group synthesis work (10%). The minimum mark required for each of the evaluation processes to average is 2.5 out of 10.
- The teacher will determine at the beginning of the course the number of evaluable practices. To pass each of the practices, an exercise score of 70 points out of 100 will be necessary. The scores will be directly proportional to said reference (eg, a 35 will be a 2.5, a 70 will be a 5, an 85 will be a 7, 5 and a 100 will be a 10)

The dates of continuous evaluation and delivery of works will be published in the Virtual Campus may be subject to possible programming changes for any reason, although it will always be reported as far in advance as possible or appropriate.

#### Conditions for approval and recovery mechanisms

To pass the course it will be necessary to obtain at least 5 points out of 10. There will only be recovery from the theory exam.

The student can appear for the recovery as long as they have been submitted to a set of activities that represent at least two thirds of the total grade for the course. Of these, students who have an average of 2.5 or higher on all the activities of the subject may be presented in the recovery.

#### Grade review procedure

For each evaluation activity, a place, date and time of review will be indicated in which the student can review the activity with the teacher. In this context, claims may be made about the grade of the activity, which will be evaluated by the teachers responsible for the subject. If the student does not appear in this review, this activity will not be reviewed later.

#### Ratings

License plates of honor. Awarding an honors degree is the decision of the teaching staff responsible for the subject. UAB regulations indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. Up to 5% MH of the total number of students enrolled can be awarded.

A student will be considered non-assessable (NA) if the weight of those equivalent to a minimum of two-thirds of the total grade for the course has not been presented in a set of activities.

#### Ethical considerations and disciplinary measures

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, irregularities committed by the student that may lead to a variation in the grade of an act of evaluation will be rated with a zero. Therefore, copying or letting a practice or any other assessment activity be copied will involve suspending with a zero, and if it is necessary to pass it to pass, the entire subject will be suspended.

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Problems solving and Laboratory Practices	20	2	0.08	3, 1, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 16, 12, 10, 13, 11, 14, 20
Research work and oral presentation on the extension of some of the topics discussed in class	10	0.5	0.02	3, 1, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 16, 12, 10, 13, 11, 14, 20, 19
Theory Examination	70	2	0.08	3, 1, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 16, 12, 10, 13, 11, 14, 20, 19

## Bibliography

Warning: See virtual campus for extensions and updates of this bibliography

## Basic bibliography

- ICAO annexes
- ICAO Doc. 9750, Global Air Navigation Plan
- ICAO Doc. 9613, Performance-based Navigation (PBN) Manual
- ICAO Doc. 9849, Global Navigation Satellite System (GNSS) Manual
- ICAO Doc. 9854, Global Air Traffic Management Operational Concept
- ICAO Doc 4444 'Procedures for Air Navigation Services - Air Traffic Management' (PANS-ATM)
- European ATM Master Plan
- Air Navigation Rules of Spain
- SERA (Standardised European Rules of the Air)
- "Navegación aérea: posicionamiento, guiado y gestión del tráfico aéreo" - SÁEZ NIETO, Francisco Javier
- "Descubrir la navegación por satélite" - DE MATEO GARCÍA, María Luz
- "Descubrir el control aéreo" - ONTIVEROS, Jorge
- "Fundamentals of air traffic control" - NOLAN, Michael S.

## Complementary bibliography

- Pilot's Handbook of Aeronautical knowledge (FAA).
- Aeronautical Information Manual (FAA).
- Global Operational Data Link Documento (OACI).
- Link 2000+ Guidance to Airborne Implementers (Eurocontrol).
- ATC Fecha Link Operational Guidance for LINK 2000+ Services (Eurocontrol).
- Flight Crew Fecha Link Operational Guidance for LINK 2000+ Services (Eurocontrol).
- Air traffic controllers ab-initio course (SENASA)
- "Mecánica del vuelo" - GÓMEZ TIerno, Miguel Ángel
- "Aerodinámica básica" - MESEGUER RUIZ, José