UAB
Universitat Autònoma de Barcelona

Navigation and Air Traffic Control Techniques

Code: 101750
ECTS Credits: 6

2025/2026

Degree	Type	Year
Aeronautical Management	OB	3

Contact

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Teaching groups languages

You can view this information at the end of this document.

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 subject reviews new and traditional technologies applied to aviation. It consists of three blocks: air navigation fundamentals, navigation systems, and control techniques. In this way, an analysis of the main aspects of air navigation is carried out, starting with the study of the related sciences and then focusing on the areas the system is composed. Priority is given to air traffic control and navigation systems. Traditional, current and innovative technologies and procedures that arrive in the process of constant change that aviation is experiencing are analyzed, along with a prospection based on the key elements that are demanded from the ATM system of the future, which allow predicting, with some accuracy, its future evolution.

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 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

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
• 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
• remote control towers

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical Sessions	16	0.64	3, 1, 18, 4, 5, 8, 9, 7, 6, 17, 12, 13, 10, 14, 20
Theory Classes	30	1.2	1, 18, 4, 5, 8, 9, 6, 16, 12, 13, 10, 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, 13, 10, 11, 14, 20, 19
Seminars Preparation	20	0.8	3, 2, 8, 9, 7, 6, 15, 17, 14, 20, 19
Study	45	1.8	3, 1, 18, 4, 5, 8, 9, 7, 6, 17, 16, 12, 13, 10, 11, 14, 20, 19

The general methodological approach of the subject is based on the principle of using a variety of strategies, with the aim of encouraging active participation and allowing students to construct their own learning process. In this regard, the course will include full-group lectures, practical activities, participatory debates, and processes for monitoring student work.

COURSE DEVELOPMENT

To deliver the subject and its seminars, PowerPoint presentations and short videos will be used.
All topics are complemented by practical laboratory sessions. Students will also be provided with materials for exercises such as aeronautical charts, load sheets, flight plans, METAR/TAF reports, etc.

USE OF ARTIFICIAL INTELLIGENCE-BASED TECHNOLOGY

Restricted use: For this subject, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks, such as bibliographic or information searches, text correction or translation, or for identifying techniques to solve specific parts of an activity provided that the student is able to understand what the AI technology provides and integrate it into their own problem-solving or activity development process. Under no circumstances is it permitted to use AI technologies to directly obtain the solution to an assigned activity. For this reason, when submitting their proposed solution to an assessable activity, the student must clearly identify which parts were generated using this technology, specify the tools used, and include a critical reflection on how these influenced both the process and the final outcome of the activity. A lack of transparency in the use of AI in such activities will be considered academic dishonesty and may result in partial or full penalties in the activity grade, or more serious sanctions in severe cases.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory Practices	40%	0	0	3, 1, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 16, 12, 13, 10, 11, 14, 20
Theory Exam 1	30%	2	0.08	1, 18, 4, 5, 8, 7, 15, 17, 16, 12, 13, 10, 11, 19
Theory Exam 2	30%	2	0.08	3, 1, 18, 2, 4, 5, 8, 9, 7, 6, 15, 17, 16, 12, 13, 10, 11, 14, 20, 19

The evaluation of the subject includes the following elements:

Theory exams (60%): two exams, one taken halfway through the semester and the other at the end.
Practicals (40%): evaluated through laboratory reports.

Final grade calculation:

The final grade for the subject (N) will be:
N = 30% (EX1) + 30% (EX2) + 40% (Practicals)
The student passes the subject if N ≥ 5. In case of failing, the student may take part in the recovery process detailed below.

Passing conditions and recovery mechanisms

To pass the subject, the student must obtain at least 5 out of 10 points in both the overall grade of the practicals and in each of the exams.
Only the theory exams can be recovered.
Attendance to practicals is mandatory.
For any practical session the student does not attend, a zero will be given.
The student may sit for the make-up exam to recover failed or missed content or to improve their grade, but practical sessions that were not completed cannot be recovered under any circumstance.

Special grades

Honors distinctions (Matrícula d'Honor): Granting an honors grade is at the discretion of the subject's instructor.
UAB regulations state that MH can only be awarded to students who achieve a final grade of 9.00 or higher.
Up to 5% of enrolled students may receive this distinction.

A student will be considered not assessable (NA) if:

- They have not participated in any evaluable activity.

- They have not participated in one of the evaluation blocks (e.g., no exams but did attend practicals, or no practicals but did sit one or all exams).

Ethical considerations and disciplinary measures

Without prejudice to other disciplinary measures that may be applied, and in accordance with current academic regulations, any irregularities committed by a student that could affect the grade of an evaluation will be graded with a zero.
Therefore, copying or allowing others to copy a practical or any other assessment activity will result in a zero, and if that component is essential to pass the subject, the entire subject will be failed.

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

Software

None

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	11	Spanish	second semester	afternoon
(PLAB) Practical laboratories	12	Spanish	second semester	afternoon
(TE) Theory	1	Spanish	second semester	afternoon