Air navigation systems

Academic Year: (2024 / 2025) **Review date: 18-04-2024**

Department assigned to the subject: Aerospace Engineering Department

Coordinating teacher: SOLER ARNEDO, MANUEL FERNANDO

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The students are expected to have basic knowledge on air navigation: namely, the air navigation as a system (ATM-CNS concept) and basic principles about meteorology, altimetry, anemometry, etc.

OBJECTIVES

GENERIC COMPETENCES AND SKILLS

GC1) Knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context

GC2) That students can apply their knowledge and ability to solve problems in new or unfamiliar environments within broader contexts (or multidisciplinary) contexts related to their field of study

GC3) Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments

GC4) Students can communicate their conclusions and the knowledge and rationale underpinning to specialists and non- specialists in a clear and unambiguous

GC5) That students have the learning skills to allow them to continue studying in a way that will have to be largely self-directed or autonomous

GC6) Capacity for the overall leadership and technical direction of research, development and innovation in aviation and space companies and technology centers

GC7) Ability to integrate complex aerospace systems and multidisciplinary teams

GC8) Ability to analyze and correct the environmental and social impact of technical solutions to any aerospace system

GC9) Ability to analyze and solve aerospace problems in new or unfamiliar environments within broader contexts and complex

GC10) Competence in all areas related to airport technologies, airborne or space which, by their nature, are not exclusive of other branches of engineering

GC11) Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of Aeronautical Engineering

SPECIFIC COMPETENCES AND SKILLS RELATED TO AIR NAVIGATION

SC1) Ability to define and design navigation systems and air traffic management , and to design the airspace, aeronautical and maneuvers .

SC2) Competence to plan, design , manage and certify procedures , infrastructure and systems that support the aerospace activity, including navigation systems

SC3) Adequate knowledge of Avionics and board Software, and Control Simulation and techniques used in air navigation.

SC4) Adequate knowledge of wave propagation and the problem of links with Earth Stations.

SC5) Ability to design systems and Radar Aids related to Air Navigation.

SC6) Adequate knowledge of Information Technology and Communications Aircraft.

SC7) Adequate knowledge of the various regulations for navigation and circulation areas and ability to certify the Air Navigation Systems.

ADDITIONAL COMPETENCES AND SKILLS RELATED TO AIR NAVIGATION

AC1) Basics on optimization.

AC2) Different simulation environments related to air navigation.

LEARNING THROUGHPUT

Upon completion of the course the student should be able to:

Understand, define and design the systems and navigation equipment and air traffic management . A better understanding of the different regulations for navigation and circulation areas in order to have the ability to certify elements of air navigation systems.
Solve electromagnetic problems and evaluate the design of antennas shipped.
Analyze existing systems air traffic control and evaluate future trends.
Evaluate the performance of subsystems navigation, guidance and control of the aircraft.
Implement advanced techniques for navigation and control of computer-based aircraft.

DESCRIPTION OF CONTENTS: PROGRAMME

Block I: The air navigation system nowadays

1 ATM/CNS (Air Traffic Management/Communication, Navigation, and Surveillance) concept.
2 Meteorology
3 Aeronautical charts, maneuvers and procedures.
4 Air routes and flight planning.
5 Performances, GNC (Guidance, Navigation, and Control) --> INS, GNSS, Kalman Filter.

Block II: Future trends towards a modernized air navigation system

7 Introduction to SESAR and NextGen
8 Introduction to optimization
9 ATFM (Air Traffic Flow Management) modeling
10 conflict detection and resolution algorithms.
11 Trajectory Management in ATM

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

Lectures

Practical classes/Exercises

Laboratories in computer classroom

Individual student work

TEACHING METHODOLOGIES

Exposition in class with teacher support and audiovisual media, in which the main concepts of the subject are developed and the literature is provided to supplement student learning.

Critical reading recommended by the subject teacher texts: Newspaper articles, reports, manuals, and/or scholarly articles, either for subsequent class discussion, either to expand and consolidate the knowledge of the subject.

Solving practical cases, problems, etc.. posed by the teacher individually or in group

Field Visit

ASSESSMENT SYSTEM

% end-of-term-examination:	25
% of continuous assessment (assigments, laboratory, practicals…):	75

Continuous Evaluation: 75% of the mark
Final exam: 25% of the mark.

Minimum mark in the final to pass the course: 4

The continuous evaluation will be based on Laboratories, Case studies/exercises, and a midterm exam

Lab 1 (Flight Simulator)
Lab 2 (ATFM algorithms)
Lab 3 (Collision avoidance algorithms)
Lab 4 (Off-the-Shelf Software Simulation)
Homework Exercises/Assignments: Flight Plan, Optimization
Midterm exam: It will be partially or enterilly based on computer-based exercises.

Case studies/exercises to be assessed during the lectures.

The student should notice that the final exam will consist of two parts: theoretical and practical. The practical part may be based on computer-based exercises.

BASIC BIBLIOGRAPHY

- Daniel Delahaye, Ste¿phane Puechmorel Modeling and Optimization of Air Traffic, Wiley-ISTE (2013), 2013

- James Wolper Understanding Mathematics for Aircraft Navigation, McGraw Hill Professional, 2001

- Mike Tooley and David Wyatt Aircraft communications and navigation systems. Principles, maintenance and operation, Routledge, 2007

ADDITIONAL BIBLIOGRAPHY

- DAvid Titterton and John Weston Strapdown Inertial NAviagtion Technology, IEEE, 2004, 2nd edition

- Javier LLoret Introduction to Air Navigation - A technical and operational approach, Javier Lloret [Ed], 2016, second edition

- Nolan Fundamentals of air traffic control, Cengage learning, 2010

- Pérez, Arnaldo, Sáez, Blanco, Gómez El sistema de Navegación Aérea, Garceta, 2013

- Rogers Applied Mathematics in Integrated Navigation Systems, AIAA, 2003

- Stolzer Safety Management Systems in Aviation, Ashgate, 2010

- Sáez-Nieto, Francisco Javier Navegación Aérea: Posicionamiento, guiado y control , Garceta, 2012