Advanced Flight Mechanics

Academic Year: (2024 / 2025) **Review date: 23-04-2024**

Department assigned to the subject: Aerospace Engineering Department

Coordinating teacher: Zhou Zhu, Jiewei

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Classical Mechanics
Aerodynamics
Differential Equations and Linear Algebra

OBJECTIVES

Students at the end of the course should be able to:
- Become familiar with the dynamical description of aerospace vehicles as rigid bodies.
- Solve and analyse the motion of an aerospace vehicle after being perturbed.
- Understand the effect of the actuators in the motion of the vehicle.
- Design control algorithms to get the desired response of an aerospace vehicle in certain conditions.
- Have the required knowledge and understanding to provide a basis for original development, often within a research context.
- Apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
- Integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited.
- Communicate their conclusions and the knowledge and rationale underpinning to specialists and non-specialists in a clear and unambiguous way.
- Acquire the learning skills to allow them to continue studying in a self-directed or autonomous way.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction
2.- General equations of non-stationary motion
    2.1 - Derivatives of stability
    2.2.- Longitudinal stability of uncontrolled motion
    2.3.- Lateral-directional stability of uncontrolled motion
    2.4.- Response to the action of controls. Open loop.
3.- Aerospace navigation elements
4.- Closed loop control
5.- Handling qualities

LEARNING ACTIVITIES AND METHODOLOGY

FORMATION ACTIVITIES
AF1 - Theoretical class
AF2 - Practical class
AF3 - Practice in computer room
AF5 - Individual student work
AF6 - Tutoring
AF7 - Midterm and final exams

TEACHING METHODOLOGIES
MD1 - Lectures given by the teacher with the support of computer and audiovisual media, in which the

main concepts of the subject are developed and bibliography is provided to supplement the students' learning. About 60% of the theoretical classes AF1 follow the MD1 description.

MD2 - Critical reading of texts recommended by the teacher of the subject: Press articles, reports, manuals and/or academic articles, either for subsequent discussion in class, or to expand and consolidate knowledge of the subject. Additional material is available to students in Aula Global: scientific articles, and specialised press articles related to the subject.

MD3 - Resolution of practical cases, problems, etc. raised by the teacher individually or in groups.
The practical classes AF2 and AF3 correspond to the MD3 description. Associated with this work, a continuous evaluation is carried out.

MD4 - Presentation and discussion in class, under the teacher's moderation, of topics related to the content of the subject, as well as practical cases.
For the continuous evaluation, it is based on the presentation of the results obtained in the assigned work.

MD5 - Preparation of work and reports individually or in groups.

The tutorings are carried out during the schedule published in Aula Global, making an appointment in advance by email.

ASSESSMENT SYSTEM

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

The continuous evaluation includes assignments, exercises, tests, and a computer exam; and represent a 75% of the total grade.

The end-of-term exam represents the remaining 25% of the total grade.

In order to pass the subject, two requirements need to be met:

1) to have a minimum grade of 4.0/10 in the end-of-term exam;
2) to have a minimum overall grade (considering end-of-term exam and continuous evaluation) of 5.0/10.

Only in the extraordinary call, it will be possible to pass the subject either by meeting the previous two requirements or by having a minimum grade of 5.0/10 in the final exam.

BASIC BIBLIOGRAPHY

- Ashish Tewari Atmospheric and Space Flight Dynamics, Birkhäuser, 2007

- Bernard Etkin and Lloyd Duff Reid Dynamics of Flight: Stability and Control (Third Edition), Wiley, 1996

ADDITIONAL BIBLIOGRAPHY

- Michael V. Cook Flight Dynamic Principles (Third Edition), Butterworth-Heinemann, 2012