Course guide
220027 - MV - Flight Mechanics

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering.

Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Miquel Sureda

Others: Àlex Ferrer

PRIOR SKILLS

Flight Mechanics require an accurate knowledge of Calculus, Differential Geometry, Classical Mechanics, Aerodynamics and Rigid Body Physics. The subjects that should have been taken in order to follow normally Flight Mechanics are: all related to Mathematics, Physics and Mechanics of the first years, plus Aerospace Vehicles (2nd A), Propulsive Systems (2nd B) and Aerodynamics (3rd A).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. GrETA - An adequate understanding of the following, as applied to engineering: physical phenomena of flight, flight qualities and control, aerodynamic and propulsive forces, performance and stability.
CE23-GREVA. Adequate and applied knowledge in engineering: physical phenomena of flight, its qualities and control, aerodynamic and propulsive forces, performance, and stability. (Specific technology module: Aircraft)

Basic:
CB02-GREVA. That students can apply their knowledge to their work or vocation in a professional manner and possess the competencies typically demonstrated through the development and defense of arguments and problem-solving within their field of study.

TEACHING METHODOLOGY

The theory lessons will consist in 2 hours-long lessons in which the teacher will introduce the basic fundamentals of the applied science "flight mechanics".

The practical lessons will consist in 2 hours long tutored sessions where the teacher will present practical cases and the students, individually or in small groups, will have to solve them in order to obtain practical learning. The teacher will support the students, guiding them without harming the autonomous learning.

The mid-term and final exams will consist in a test, to evaluate theory, and a practical exercise with the same level of difficulty of the ones solved in class.

LEARNING OBJECTIVES OF THE SUBJECT

The main objectives are:
1. Introduce the fundamental ideas in a rigorous way and calculus techniques of performances, stability and static and dynamic control of the airplanes.
2. Get the students to understand the fundamentals of Flight Mechanics.
3. Get the students to acquire the basic skills associated with the discipline.

Furthermore, it is intended to promote the use of self-criteria and the application of the critic sense to the applied science of Flight Mechanics. It will be emphasised the formulation of physical and mathematical models of simple flight that allow to approach more complex situations, n the extraction of conclusions about the influence of the parameters of design in airplane flight, in the application of theoretical methods that take place at not conventional situation, and in the recognition of the conditions of validity of the obtained results.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	28,0	18.67
Hours large group	32,0	21.33

Total learning time: 150 h

CONTENTS

1. Introduction to Flight Mechanics

Description:
Introduction to Flight Mechanics

Full-or-part-time: 6h
Theory classes: 2h
Practical classes: 2h
Self study : 2h

2. Basic reference systems

Description:
The main reference systems employed in Flight Mechanics and the angular relationships between them are defined.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

3. General equations of motion of a plane

Description:
The Euler equations of motion of the plane are formulated.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

4. Basic relations for the determination of performances

Description:
The momentum theorem is set, the linear kinematic equations are developed, and the generic functional relationships for the aerodynamic and propulsive characteristics of the aircraft are established.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

5. Glider performance

Description:
Closed analytical solutions are deduced from the equations of quasi-stationary and quasi-rectilinear symmetric flight in a vertical plane, for the case of a glider.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

6. Performance of planes with turbojets

Description:
Integral and single-point performance of turbojet planes are analyzed.

Full-or-part-time: 18h
Theory classes: 4h
Practical classes: 4h
Self study : 10h

7. Static longitudinal stability

Description:
The static longitudinal stability of the aircraft is studied.

Full-or-part-time: 18h
Theory classes: 4h
Practical classes: 2h
Self study : 12h

8. Static longitudinal control

Description:
The static longitudinal controllability of the airplane is studied.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

9. Command systems. Lever forces

Description:
The stability of the plane with free controls and its relationship with the lever forces is studied.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study : 12h

10. Static lateral-directional stability and control

Description:
The concepts of stability and controllability of the aircraft in the lateral-directional case are studied.

Full-or-part-time: 18h
Theory classes: 4h
Practical classes: 2h
Self study : 12h

1. Take-Off and landing performances

Description:
Aircraft performances in each of the phase of take-off and landing are analyzed.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 2h
Self study : 6h

GRADING SYSTEM

The final mark will be calculated from 2 exams and 1 project.

The partial exam (Ex_P) will evaluate lessons 1 - 7, and the final exam will evaluate lessons 8 - 12.

The project (Proj) will take place during the course.

Final Mark = 0.4*Ex_P + 0.2*Proj + 0.4*Ex_F

The unsatisfactory results of the partial exam can be corrected through a written exam that will take place the same day of the final exam. This exam can be taken by students with a mark lower than 5 in the partial exam. The mark obtained in this exam will replace the initial mark only when it is higher than this one.

EXAMINATION RULES.

The exams will consist in a theoretical part and a practical exercise. The theory will be evaluated by a test, and will be done without help of auxiliary material. The practical exercise will be done with the help of a equations sheet given by the teacher.

BIBLIOGRAPHY

Basic:
- Gómez, M. A.; Pérez, M.; Puentes, C. Mecánica del vuelo. Madrid: Escuela Técnica Superior de Ingenieros Aeronáuticos, 2009. ISBN 9788493535025.

Complementary:
- Miele, A. Flight mechanics, vol.1, Theory of flight paths. Massachusetts: Addison-Wesley, 1962.
- McCormick, B. W. Aerodynamics, aeronautics and flight mechanics. 2nd ed. New York: John Wiley & Sons, 1995. ISBN 0471575062.
- Etkin, B.; Reid, Ll. D. Dynamics of flight: stability and control. 3rd ed. New York: John Wiley & Sons, 1996. ISBN 0471034185.