Last update: 23-04-2019

220027 - Flight Mechanics

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Spanish

Teaching staff

Coordinator: Del Campo Sud, David

Others: Del Campo Sud, David

Opening hours

Timetable: To be arranged with the teacher.

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.

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.

220027 - 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

Total learning time: 150h	Hours large group:	32h	21.33%
	Hours medium group:	28h	18.67%
	Self study:	90h	60.00%

Last update: 23-04-2019

220027 - Flight Mechanics

Content

1. Introduction to Flight Mechanics

Learning time: 6h

Theory classes: 2h
Practical classes: 2h
Self study : 2h

Description:
Introduction to Flight Mechanics

2. Basic reference systems

Learning time: 10h

Theory classes: 2h
Practical classes: 2h
Self study : 6h

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

3. General equations of motion of a plane

Learning time: 10h

Theory classes: 2h
Practical classes: 2h
Self study : 6h

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

4. Basic relations for the determination of performances

Learning time: 20h

Theory classes: 4h
Practical classes: 4h
Self study : 12h

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.

220027 - Flight Mechanics

5. Glider performance	Learning time: 10h Theory classes: 2h Practical classes: 2h Self study : 6h

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.

6. Performance of planes with turbojets	Learning time: 18h Theory classes: 4h Practical classes: 4h Self study : 10h

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

7. Static longitudinal stability	Learning time: 18h Theory classes: 4h Practical classes: 2h Self study : 12h

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

8. Static longitudinal control	Learning time: 10h Theory classes: 2h Practical classes: 2h Self study : 6h

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

220027 - Flight Mechanics

9. Command systems. Lever forces	Learning time: 20h Theory classes: 4h Practical classes: 4h Self study : 12h
Description: The stability of the plane with free controls and its relationship with the lever forces is studied.	

10. Static lateral-directional stability and control	Learning time: 18h Theory classes: 4h Practical classes: 2h Self study : 12h
Description: The concepts of stability and controllability of the aircraft in the lateral-directional case are studied.	

1. Take-Off and landing performances	Learning time: 10h Theory classes: 2h Practical classes: 2h Self study : 6h
Description: Aircraft performances in each of the phase of take-off and landing are analyzed.	

Qualification system

The final mark will be calculated from 2 exams and 2 practical exercises.

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

The exercises (Ej_1 and Ej_2) will be 2 practical exercises and they will take place in the practical lessons (medium group).

Final Mark = 0.4*Ex_P + 0.1*Ej_1 + 0.4*Ex_F + 0.1*Ej_2

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.

Last update: 23-04-2019

220027 - Flight Mechanics

Regulations for carrying out activities

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.

The deliverable exercises will take place during class time (medium group) and the auxiliary material available will depend on the type of exercise.

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.

Etkin, B.; Reid, Ll. D. Dynamics of flight: stability and control. 3rd ed. New York: John Wiley & Sons, 1996. ISBN 0471034185.

McCormick, B. W. Aerodynamics, aeronautics and flight mechanics. 2nd ed. New York: John Wiley & Sons, 1995. ISBN 0471575062.