1. BASIC INFORMATION

Course	Flights Mechanics
Degree program	Aerospace Engineering
School	Escuela de Ingeniería, Arquitectura y Diseño, UEM
Year	3
ECTS	6
Credit type	Mandatory
Language(s)	English
Delivery mode	Face to face
Semester	Second
Academic year	2024-25
Coordinating professor	Raul Llamas (raulcarlos.llamas@universidadeuropea.es)
Professor	Victor García Bennet

2. PRESENTATION

Flight Mechanics is the area of the Physics of Flight devoted to the study and analysis of the stability, controllability and flight performance of aerospace vehicles. Aircraft are required to fly safely in all points of their flight domain, and this requires that the pilot (or an automatic flight control system) may be able to control the trajectory and attitude of the aircraft using normal piloting skills and forces. Aircraft performance studies the power required to fly, fuel consumption, range, endurance and take-off and landing field lengths.
Flight Mechanics is one of the cornerstones of aerospace engineering as it integrates knowledge of aerodynamics, propulsion, aircraft systems and control theory to enable the calculation of aircraft handling qualities and performance. The safe flight of aircraft relies on adequate stability and control characteristics which need to be “designed” in the aircraft and substantiated by flight test. The economic and environmental impact of flight is minimized through the design of high performance aircraft and the calculation of important design parameters like fuel consumption and field length is also part of the subject of flight mechanics.
This subject is part of module "Aerospace Vehicles II" which includes the following subjects: 1- Aeronautical Structures and Vibrations, 2- Aerodynamics and Aeroelasticity, 3- Space Vehicles and Missiles, 4- Flight Mechanics, 5- Maintenance and Certification of Aerospace Vehicles, 6- Aircraft Design.

3. COMPETENCIES AND LEARNING OUTCOMES

Basic competencias:

- CB3: That students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflection on relevant social, scientific, or ethical issues.

Cross-curricular competencies:

- Capacity for the design, development and management in the field of aeronautical engineering whose purpose, in accordance with the knowledge acquired as established in section 5 of Ministerial Order CIN / 308/2009, is aerospace vehicles. CT1
- Planning, drafting, direction and management of projects, calculation and manufacturing in the field of aeronautical engineering whose purpose, in accordance with the knowledge acquired as established in section 5 of Ministerial Order CIN / 308/2009, vehicles aerospace.CT2
- Deal with problems and challenges related to their field of knowledge with flexibility, initiative, innovation, and dynamism (Profile owner). CT17
- Work in interdisciplinary teams, providing the greatest efficiency on the basis of cooperation, assuming their role within the team, establishing good relationships and exchanging information, and practicing the culture of peace and solidarity (Teamwork). CT19

Specific competencies:

- Adequate Engineering knowledge applied to: Aircraft systems and automatic flight control systems for aerospace vehicles. CE24
- Adequate and applied Engineering knowledge of: aeronautical design and project calculation methods; the use of aerodynamic experimentation and the most significant parameters in its theoretical application; handling of the experimental techniques, equipment and measuring instruments typical of the discipline; the simulation, design, analysis and interpretation of experimentation and operations in flight; aircraft maintenance and certification systems. CE25
- Applied knowledge of: aerodynamics; mechanics and thermodynamics, flight mechanics, aircraft engineering (fixed wing and rotary wings), structures theory. CE26

Learning outcomes:

- LO1: Carry out studies in which the technologies and engineering procedures related to the competencies of this module come into play.
- LO2: From a series of requirements, and prior information, conceptualize an engineering problem, using the right approach to solving it, and develop the best solution. All of this using the competencies of this module.

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CT1,CT2, CT17, CT19,CB3	LO1
CE24, CE25, CE26, CB3	LO2

4. CONTENT

UNIT 1: Revision of Aerodynamics

- Revision of airfoil, wing and aircraft aerodynamics (aerodynamic lift, drag and moments)

UNIT 2: Static stability and control

- Definition of stability and controllability
- Longitudinal aircraft static trim. Neutral point and static margin
- Propulsive and configuration effects
- Lateral-directional stability. Aircraft roll and dihedral effect
- Lateral control and manoeuvrability
- Description of the flight controls system
- Control forces. Actuation systems
- Flight control computers; fly-by-wire and augmented stability

UNIT 3: Dynamic stability and control. Handling Qualities

- Linearised equations of motion
- Longitudinal eigenmodes (short period and phugoid). Pitch control
- Lateral-directional eigenmodes (spiral mode, Dutch-Roll)
- Aircraft Handling Qualities (Harper-Cooper scale)

UNIT 4: Revision of Propulsion

- Revision of propulsive forces on propeller, turbofan and turbojet engines

UNIT 5: Aircraft performance

- Gliding flight and coordinated turn
- Available and required power for flight
- Computation of Range and endurance
- Calculation of take-off field length
- Calculation of time and fuel consumption in climb to ceiling

UNIT 6: Flight simulation

- Introduction to flight simulation
- Aircraft mathematical modeling
- Practical exercises with a flight simulator

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Survey of goals and interests of the students
- Master classes
- Laboratory practices
- Design, research and problem solving as teamwork
- Individual design assignments
- Simulation
- Case studies
- Field experiences, conferences, visits to companies and institutions.

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Campus-based mode:

Learning activity	Number of hours
Master Classes	44
Individual and group work	100
Tutoring, academic monitoring and evaluation	6
TOTAL	**150**

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Campus-based mode:

Assessment system	Weight
1. Exams, tests and other test of knowledge	30% min
2.Preparation of articles and reports	30% min
3. Alternative means of assessment (if applicable)	15% max
4. Field experiences, lectures, and visits (if applicable)	10% max
5. Transversal competences (rubrics) (if applicable)	10%

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

7.1. First exam period

To pass the course in the first exam period, you must obtain a final course grade of at least 5 out of 10 (5/10) in the final grade (weighted average) of the course.

In any case, you will need to obtain a grade higher or equal to 4.0 in the final exam in order that it can be averaged with the rest of the activities. Otherwise, the final course grade will be equal to the mark in the final exam.

Minimum marks required to pass in ordinary call:

- 4/10 in the written final examination.
- 4/10 in each of the individual assessments.
- All the assignments corresponding to the ordinary call delivered and uploaded in time. Assessments delivered late will be marked with a 4 or the actual grade if lower than 4.
- 50% class attendance

General considerations on the course assessment:

- The final grade is a weighted average of the assessments of all the activities undertaken during the course, with the following weights in ordinary call:
    - The evaluation of the activities of continuous assessment represents the 70% of the final grade of the subject.
    - Final examination: 30% of the final grade of the subject.
- To be graded the student must show a 50 % class attendance. Students who do not attend at least 50% of the classes will automatically fail in ordinary call and must recover the course in the extraordinary call.
- Students who, for justified reasons, cannot attend 50% of classes must obtain an authorization from their tutors and communicate in advance their situation to the lecturer.

7.2. Second exam period

To pass the subject in extraordinary call the students must obtain a mark higher or equal to 5/10 in the final grading (as a weighted average) of the course.

In any case, the students must obtain a mark higher or equal to 4/10 in the extraordinary examination and specific extraordinary assignment so that they can be averaged with the rest of the activities.

The students must upload all the assignments not delivered in ordinary period in order to be graded in the extraordinary call.

The content of the specific extraordinary assignment will be published two days after the publication of the final grades in ordinary call. In general, the assignment will cover all the topics of the course and therefore will be a substantial piece of work.

Evaluation activities in extraordinary call:

- Individual specific project: 50 % (there will be a test of authorship for the assessment of individual students)

- Written final examination (**closed book**): 50 % of the grade. **There will be no access to any kind of documentation, online sources or class notes in this test.**
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Minimum requirements to pass in extraordinary call:

- 4/10 in the extraordinary written examination.
- 4/10 in the individual assessment of the project.
- 5/10 overall
- All the assignments corresponding to the ordinary call uploaded.

8. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

Assessable activities	Deadline
Report on Aircraft Accident analysis	Check Canvas
Report on Aircraft Performance assessment of a large commercial aircraft. 20%	Check Canvas
Report on basic Aircraft Design and Aircraft Stability analysis 10%	Check Canvas
Report on wing optimization and performance analysis of a small aircraft 20%	Check Canvas
Written test final integrative	Check Canvas

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

The main reference work for this subject is:

- PHILLIPS, W, *Mechanics of Flight*, Wiley. 2nd ed. 2009, ISBN-10: 0470539755

Additional references will be given during the course and will include other relevant textbooks, research papers and general literature (e.g. current events, accident reports, etc...)

10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.
From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.

12. CODE OF ETHICS

Each student must abide by the code of ethics of the School of Architecture, Engineering and Design of the European University of Madrid.
Every student must obey the rules of the School and behave respectfully towards the lecturers and fellow classmates.
The lecturer is authorized to expel any student from class when he / she is disturbing the good order of the session.
Students who commit a serious disciplinary offense will be subject to disciplinary procedure of the University.

In particular, students found copying or committing plagiarism or fraud will automatically fail the subject in that call with a grade of 0. In addition, in these cases, the University may open a disciplinary dossier as per the European University internal regulations and the legislation of the Spanish Ministry of Universities.