1. BASIC INFORMATION

Course	Aircraft Design
Degree program	Aerospace Engineering
School	Escuela de Ingeniería, Arquitectura y Diseño, UEM
Year	4
ECTS	6
Credit type	Compulsory
Language(s)	English
Delivery mode	Face to face
Semester	1st
Academic year	2023-2024
Coordinating professor	Raul Llamas raulcarlos.llamas@universidadeuropea.es

2. PRESENTATION

The course "Aircraft Design" culminates the student's aeronautical education in the Aerospace Engineering degree. Those students who have chosen these studies by vocation will have the opportunity to develop their dream of designing their own aircraft based - for the first time - on their technical knowledge. All aspects of conceptual and preliminary aircraft design are covered in this subject. Students will develop skills in the synthesis and assessment of the aircraft configuration and its components, the identification of design conflicts, the selection of technologies and materials, graphic design and the application of certification regulations.

The subject belongs to the area "**AEROSPACE VEHICLES II**" and is related to the following subjects:

- **Aeronautical Structures and Vibrations** 6 ECTS (third year)
- **Aerodynamics and Aeroelasticity** 6 ECTS (third year)
- **Space Vehicles and Missiles** 6 ECTS (third year)
- **Flight Mechanics** 6 ECTS (third year)
- **Maintenance and Certification of Aerospace Vehicles** 6 ECTS (third year)

3. COMPETENCIES AND LEARNING OUTCOMES

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

Competencies	Learning outcomes
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, aerospace vehicles.CT1	Carry out studies in which the technologies and engineering procedures related to the competencies of this module come into play.
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	
Adequate Engineering knowledge applied to: Aircraft systems and automatic flight control systems for aerospace vehicles. CE24	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.
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	

4. CONTENT

The subject "Aircraft Design" covers the following topics in a functional approach:

Topic 0; Geometric Design of aircraft

0.1 Representation of the aircraft
0.2 Software for geometric design of aircraft
0.3 Open software for general design of aircraft

1 Transport and protection of the payload function

1.1 Passenger cabin, cockpit. Level of comfort and ergonomics. Doors, evacuation slides. Loading ramps. Toilets, galleys, overhead compartments and cockpit elements. Regulations. Design of the cross-section of the fuselage. Design of the cockpit, angles of view and ergonomics. Cargo compartments. Standard containers ("Pallets") and bulk. Cargo loading systems of the aircraft. Loading ramps.

1.2 Fuselage: structural types. Fuselage structures: Frames, beams, bulkheads, doors, keel beam, torsion box, center box, wing joint. Design and use of post-buckled skins, diagonal tension. Pressurization, fatigue and damage tolerance. Insulation, noise and fire protection. Safety considerations for crashworthiness. Certification regulations. Materials, manufacturing and assembly. Systems installation.

1.3 External shapes, aerodynamic considerations. Tailstrike angle.

2 Lift generation function

2.1 Geometry of Wings and Lifting Surfaces. Planform definition.

2.2 Aerodynamic design for high speed and low speed. High-lift devices. Wing-tip devices.

2.3 Structures: torsion box; spars, ribs, stringers and covers. Leading and trailing edge structures. Pylons and landing gear attachments. Center joint. Movables: flaps, slats, ailerons, and spoilers.

3 Ground interface function

3.1 Landing gear. Types. Retraction and extraction systems. Integration with the rest of the aircraft. Design constraints. Wheels, ACN category, certification regulations.

3.2 Ground servicing.

4 Stability and control function of the aircraft

4.1 Flight controls, control surfaces, actuation systems.

4.2 Empennage and stabilizers. Flying qualities and functions of the controls.

4.3 (Air)Braking function and lift spoilers.

5 Propulsive function

5.1 Types of classic propulsive systems and their optimal regime of operation.

5.2 Integration of the power plant and propulsive system with the airframe.

5.3 Specific regulations.

5.6 Future propulsive systems and sources of energy.

6 Distribution of energy and fluids function

6.1 Aircraft systems: Fuel, hydraulic, electrical, pneumatic, air conditioning, pressurization, fire detection and protection system, oxygen, Auxiliary Power Unit. Fuel tanks.

7 Synthesis of aircraft configuration

7.1 Sizing of aircraft of conventional configuration. Three views drawings and general arrangement. Payload-range diagram. Optimization: W/S, T/S, sizing of the wing and the engines. Aircraft performance.

7.2 Unconventional configurations; advantages and specific problems. “Radical” configurations.

7.3 Phases of the design of the aircraft: conceptual, preliminary and detailed. Organization of the design office.

8 Helicopters and unmanned aircraft. Autonomous aircraft

8.1 Introduction to rotary-wing aircraft

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies that will be used are:

1. Survey of goals and interests of the students
2. Master classes
3. Laboratory practices
4. Design, research and problem solving as teamwork
5. Individual design assignments
6. Simulation
7. Case studies
8. Field experiences, conferences, visits to companies and institutions

6. LEARNING ACTIVITIES

The table below shows the types of training activities that will be performed and the expected hours of dedication of the student to each of them:

Training activity	Number of hours
1. Master Classes	60
2. Group integrative exercises	50
3. Individual work	60
4. Tutoring, academic monitoring and evaluation	6

7. EVALUATION

The table below shows the performance evaluation methods, as well as their corresponding weight on the final grading of the subject:

Evaluation 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% max

In the Virtual Campus, when you access the course, you'll be able to consult in detail the assessment activities that you must perform, as well as the dates of delivery and the evaluation procedures of each of them.

7.1. First exam period (ordinary call)

To pass the subject in ordinary period you will need to obtain a mark higher or equal to 5.0 out of 10.0 (5/10) in the final grade (weighted average) of the course.

In any case, you will need to obtain a mark higher or equal to 4.0 in the final examination 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.

The gradable items are the following:

- **Individual report of the group design project of FAR/CS 25 aircraft design.** The following technical skills are evaluated:

- Ability to integrate the knowledge acquired during the degree and the course in the design of the component of the aircraft corresponding to the student.
- Demonstrate competence in technical communication in oral (presentations to the lecturer and the rest of the class) and written forms.
- Creativity and technical innovation, showing deep technical and business knowledge beyond that presented in the master classes.

The group presentations will be held in two sessions, the first around 4 weeks after the beginning of the course and a final one on the last day of class before the exam. In the first session the students will upload to Canvas a preliminary report (a presentation in pdf format) showing and explaining the configuration of their component and their design choices. In the last session the students will upload to Canvas the full report and the presentation of the final design of their component.

- **Project report individual design of aircraft (FAR/CS-23).** The following technical skills will be assessed:
  - Ability to integrate the knowledge acquired during the degree and the course in the design of an aircraft by the student.
  - Communication skills, technical writing and graphic design (correct technical drawings of the aircraft and its components, including hand drawings and a possible CAD or 3D model, or equivalent).
  - Creativity and technical innovation, showing to have researched beyond the content presented in the master classes.

Around 4 weeks after the beginning of the course (check details in the course page), the students will upload to Canvas a document (in pdf format) including development hand sketches, a study of competitor aircraft, a three views drawing of their aircraft, and a complete presentation with the justification of design choices. A week before the end of classes the students will upload the full report of their design, in the format of a text document written in correct technical style (in pdf format).

Individual research assignments on various topics (see below)

Final examination. To evaluate the student's technical skills specific to the design of aircraft. The content to be evaluated will be clearly identified during the classes and in the teaching materials.

Full list of assessment activities in the ordinary call:

- Individual assignment to model the geometry of a designated aircraft in OpenVSP 10%
- Individual assignment to report on a given aerospace market niche 10%
- Group design project of a FAR/CS 25 aircraft component: first delivery 5%, final delivery 10%
- Individual design project of a FAR/CS23 aircraft: first delivery 5%, final delivery 10%
- Individual report on new propulsive systems and the sustainability of aviation 10%
- Individual report on current and future air combat systems (e.g. 5th and 6th generation fighters) 10%
- Final written examination (open book in ordinary call): 30 % of the grade

Minimum marks required to pass in ordinary call:

- 4/10 in the written final examination.
- 4/10 in the individual assessment of the group design project.
- 4/10 in the individual assessment of the individual design project.
- All the assignments corresponding to the ordinary call delivered and uploaded in time.
- 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.

The students who for justified reasons are unable to deliver assignments or sit examinations in time must obtain an authorization from their tutor and communicate immediately their situation to the lecturer who will then set a date and time for the student to recover the activities.

7.2. Second exam period (extraordinary call)

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.

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 in this test.

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
Exercise of generation of geometry plane	Check Canvas
Report on market niche in the design of the aircraft	Check Canvas
Group project of design of aircraft (FAR/CS 25)	Check Canvas
Individual project design of aircraft (FAR/CS23):	Check Canvas
Individual report on new systems propulsivos to the sustainability of the aviation	Check Canvas
Individual report on fighter aircraft, 5th and 6th generation	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

Course textbook (available in the library of the UEM)

"General aviation aircraft design", Gudmundsson, Snorri, 2014

Basic bibliography (available in the library of the UEM or openly online)

1. "Aircraft Design", Ajoy Kumar Kundu, Cambridge University press, 2012
2. "Aircraft Design" Online resources from Hamburg University, Prof Dieter Scholz: http://www.fzt.haw-hamburg.de/pers/Scholz/HOOU/
3. "Understanding Aircraft Structures", J. Cutler, Fourth Edition, Blackwell, 2006
4. "Civil Jet Aircraft Design", L. R. Jenkinson, P. Simpkin, D. Rhodes, Elsevier, 1999
5. "Aircraft Design, a conceptual approach", D. P. Raymer, Fourth edition, AIAA, 2006
6. "Lessons learned in aircraft design", J. Roskam, Darcorp, 2007
7. "The design of the aeroplane", D. Stinton, Blackwell, 2001
8. "Airframe structural design", M. Niu, Second edition, Adaso, 2006
9. "Synthesis of subsonic Airplane Design", E. Torembeek, Delft, 2010
10. "AERODYNAMIC DESIGN OF TRANSPORT AIRCRAFT", Ed Obert, Delft University of Technology, 2009

Additional bibliography

11. “Airplane Design Parts I through VIII”, J. Roskam, Darcorp, 2003
12. “Evolution of the Airliner”, R. Whitford, Crowood, 2007
13. “Advanced Aircraft Design: Conceptual Design, Technology and Optimization of Subsonic Civil Airplanes”, E. Torembeek, Wiley, 2013
14. “Twenty-First-Century Jet: The Making and Marketing of the Boeing 777”, K. Sabbagh, Scribner, 1996
15. “Wide-Body: The Triumph of the 747”, C. Irving, First edition, W. Morrow, 1993
16. “Unconventional Aircraft”, P. M. Bowers

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. SATISFACTION SURVEYS

Your opinion matters!

The European University encourages you to participate in satisfaction surveys to detect strengths and areas for improvement on the faculty, the degree and the process of teaching-learning.

The surveys will be available in the space of surveys of your virtual campus or through your email.

Your assessment is needed to improve the quality of the degree.

Many thanks 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.

USE OF ARTIFICIAL INTELLIGENCE IN THIS COURSE. PLEASE NOTE THE FOLLOWING

➔ please write guidelines for the ethical use of large language models to be used by engineering students and propose penalties for unethical use

ChatGPT

Guidelines for Ethical Use of Large Language Models by Engineering Students

Large language models, like GPT-3.5, are powerful tools that can be leveraged for various tasks. However, ethical considerations are paramount in their use. Engineering students should adhere to these guidelines to ensure responsible and ethical use of large language models:

1. **Respect Privacy and Data Security:**
   - Do not request, share, or use personal or sensitive information inappropriately.
   - Protect data privacy and adhere to relevant data protection laws (e.g., GDPR).
2. **Avoid Harmful Content:**
   - Do not use large language models to create or promote harmful, illegal, or unethical content.
   - Refrain from generating content that could incite violence, hate speech, harassment, or discrimination.
3. **Acknowledge Model Limitations:**
   - Understand that language models may generate inaccurate or biased information based on their training data.
   - Use critical thinking and fact-checking to verify information generated by the model.
4. **Guard Against Bias:**
   - Be aware of potential biases in large language models and critically evaluate their output.
   - Refrain from perpetuating or amplifying biases, and avoid generating discriminatory content.
5. **Respect Intellectual Property:**

- Do not use large language models to generate or reproduce copyrighted material without proper attribution or permission.
- Adhere to intellectual property laws and give credit when necessary.

6. **Avoid Plagiarism:**
   - Do not use large language models to generate content that you intend to pass off as your own without proper citation or attribution.
   - Use AI-generated content as a reference or starting point and add your original contributions.
7. **Transparency and Disclosure:**
   - When using AI-generated content in academic or professional contexts, disclose the use of AI technology.
   - Inform others when AI assistance was involved in generating or assisting with content.
8. **Promote Ethical AI Usage:**
   - Encourage your peers to use large language models ethically and responsibly.
   - Share these guidelines and contribute to awareness about ethical AI usage.