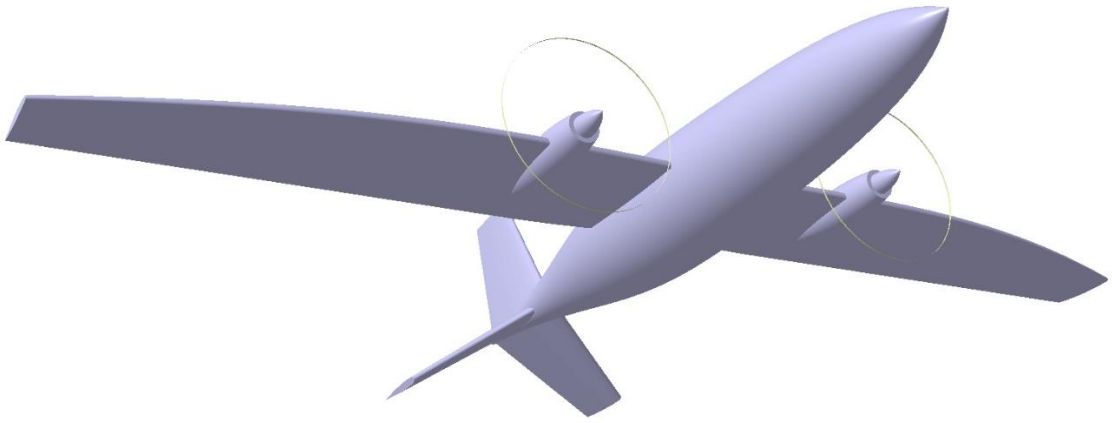
UNIVERSIDADE BEIRA INTERIOR

DEPARTAMENTO DE CIÊNCIAS AEROESPACIAIS

PROJETO DE AERONAVES
AIRCRAFT DESIGN – 15096

2025/2026



Curricular Unit Description

and

Design Project Description

PART I
THE CURRICULAR UNIT

1. OBJECTIVES

Students should acquire skills in the development of an aircraft subject to specific requirements and constraints, know how to apply aircraft design standards, develop integration, decision and compromise capabilities in a multidisciplinary team project and know how to communicate their results effectively.

With this UC students should be able to:

- describe the traditional aircraft design process and adapt it to specific cases;
- develop simple programs for the analysis and conceptual/preliminary design of an aircraft;
- integrate knowledge from various areas of science and engineering in the development of a multidisciplinary design project;
- carry out the conceptual and preliminary design of an aircraft to meet specific requirements;
- analyse design results and identify the most relevant parameters for the optimization of a given aircraft;
- effectively communicate project results;
- work in a team.

2. PREREQUISITES

It is advisable for students to have passed Aircraft Drawing, Introduction to Aircraft Development, Flight Performance, Propulsion I, Aerospace Structures I, Flight Dynamics and Simulation, and Applied Aerodynamics.

3. SYLLABUS

I. Introduction

1. Introduction to the curricular unit. 2. The aircraft design process. 3. Airworthiness standards for aircraft design.

II. Conceptual Design

4. Sizing from a conceptual drawing. 5. Selection of the airfoil and geometry of the wings and tail. 6. Initial sizing. 7. Configuration and drawing. 8. Configuration considerations. 9. Cabin, passengers and payload. 10. Integration of the propulsive system and the power system. 11. Landing gear and other systems. 12. Case studies.

III. Sizing, Analysis and Optimization

13. Aerodynamics. 14. Propulsion. 15. Structures and loads. 16. Weight and balance. 17. Stability and control. 18. Performance. 19. Cost analysis. 20. Optimization.

IV. Design of a New Aircraft

21. Concept of operations. 22. Aircraft design. 23. Development of analysis and optimization tool. 24. Sizing and analysis. 25. Oral presentations. 26. Written report.

4. SYLLABUS/OBJECTIVES

The contents of this curricular unit are structured in four blocks, the first three consisting of oral exposition and discussion of topics and the fourth consisting in practical and application of the knowledge. Those were designed with the main objective to develop teamwork skills in a complex multidisciplinary project in which theoretical and practical, technical and scientific knowledge of various areas is necessary, in which the critical thought and compromise is essential and, at the same time, to foster the spirit of innovation through research of new scientific and technological information (outside the syllabus of the course) so that the requirements of a given project can be met.

In essence, the syllabus is designed so that students can deepen, develop and integrate knowledge from different areas (aerodynamics, propulsion, structures, materials, flight performance, flight stability and dynamics, systems, etc.) to produce a viable and optimized aircraft design.

5. TEACHING METHODOLOGIES

This curricular unit is structured in two parts: one essentially theoretical and the other essentially practical. In the first part, the material is transmitted orally with multimedia slideshow support and additional information written on the blackboard. In the second part, methods for building a spreadsheet tool for analysis and optimization are taught and a new aircraft design is partially developed based on specific design requirements.

6. TEACHING METHODOLOGIES/OBJECTIVES

The methodologies adopted for this curricular unit follow the trends of similar curricular units in other universities and the experience acquired by the University of Beira Interior in the development of several unmanned aircraft and in various research and development work. This curricular unit has four weekly hours of theoretical-practical lectures and is structured in two parts: one part (2 hours) essentially theoretical and the other (2 hours) essentially practical.

In the first part, the materials (blocks I, II and III) are orally transmitted using multimedia slides and supplementary information written on the board. The slides are made available online to students in pdf format for their individual study and for reference, as they are built in the form of notes. In this part, examples of application are also presented. The discussion of the topics presented is fostered during the contact hours for better understanding by the students and for the development of their critical thought.

In the second part (block IV), methodologies are taught for the construction of an analysis and optimization spreadsheet tool. With this basis and with the knowledge of the theoretical part, students develop in teams (typically 5 students) the conceptual design and preliminary design of a new aircraft to meet the requirements provided by the teacher. During these classes, the exchange of ideas among teams is also encouraged and short oral presentations concerning the design progress are made throughout the semester. A large volume of this work must be performed outside the class period due to the considerable amount of required work. This project allows the student to develop analytical and synthesis skills, also using knowledge acquired in other curricular units, and to acquire critical decision and teamwork skills in the development of a complex system. At the end of the curricular unit the design is orally presented, and a written design report is submitted.

Although the professor monitors the developed students' work during the contact hours, both in the theoretical and practical lectures, a considerable amount of individual work outside the class is necessary by the students, regarding the study of the syllabus of the curricular unit, the study of other related subjects contained in the bibliographic references and the realization of the design work. This individual work promotes the autonomy and critical capacity of the student.

To support the teaching of this curricular unit, different but essential teaching/learning resources are used, namely:

- Video projector
- Books, articles, and other bibliography
- Notes
- Computer
- Internet
- Spreadsheets
- Analysis software for: airfoils, wings, propellers, flight stability, etc.
- CAD/CAE software
- Aircraft models developed previously at UBI and others

7. CALENDAR

Lectures are divided into two main parts: one to present and discuss the fundamental topics; and another to discuss and develop the proposed design project. In the table below the syllabus chapters are assigned to the corresponding weekly lectures.

Week	Dates	Chapters
1	-	-
	20/02/2026	1
2	23/02/2026	2, 3
	27/02/2026	4
3	02/03/2026	21
	06/03/2026	5
4	09/03/2026	5, 6
	13/03/2026	25
5	16/03/2026	6, 7
	20/03/2026	7
6	23/03/2026	8, 9
	27/03/2026	22
7	30/03/2026	break: Easter
	03/04/2026	break: Easter
8	06/04/2026	break: Easter
	10/04/2026	10
9	13/04/2026	11
	17/04/2026	22
10	20/04/2026	12
	24/04/2026	22
11	27/04/2026	13
	01/05/2026	holliday: May 1st
12	04/05/2026	25

	08/05/2026	13, 14
13	11/05/2026	14, 15
	15/05/2026	23
14	18/05/2026	15, 16
	22/05/2026	17
15	25/05/2026	17, 18
	26/05/2026	23
	29/05/2026	19, 20
16	01/06/2026	Test
	02/06/2026	24
	05/06/2026	25
17	08/06/2026	25
	-	-

The available time for questions is Thursday at 14h00-16h00.

PART II
THE DESIGN PROJECT

UAV for Disaster Relief

UAV-26

8. INTRODUCTION

In the past few years electric propulsion for aircraft has seen tremendous developments and a widespread use. Its application ranges from the model aircraft, UAVs, sailplanes, ultralight, general aviation aircraft and even passenger aircraft. Because batteries have a limited energy density, resulting in flights of short duration, the use of fuel cells for battery charging is an interesting option that has already been exploited. Conventional propulsion with a piston engine allows flights with longer duration and with the help of an alternator coupled to the engine batteries, that provide on-board power for systems, can recharge these in flight. To avoid consumption of petrol-based fuels to produce electricity, the incorporation of photovoltaic cells on the aircraft can provide part, or all, of the electrical energy required on board. In some situations, a hybrid propulsion system may be preferred.

Also, the developments in electrical propulsion, with increasing safety levels has enabled the study and implementation of several designs for urban air mobility to transport people and cargo and small passenger aircraft.

The main objective of this subject is to show students what the conceptual design of an aircraft is and what steps are necessary to follow given mission and performance requirements, design constraints, design methods and the need for optimization. To achieve this, the knowledge gained during the course will be applied to the design of a new aircraft subjected to specific requirements. The optimization of the project is of extreme importance in the development of a new aircraft.

This project description presents the requirements that the aircraft must respond to in terms of mission, layout, performance, systems, materials, and design standards. It also describes the necessary tasks to be carried out during the semester and the work plan to follow. This project requires dedication and continuous work to ensure that deadlines are met, and results lead to a good design.

9. REQUIREMENTS

The current requirements present a need for an autonomous UAV (also capable of being remotely piloted) with the capability to fly monitor catastrophe scenarios and follow the ongoing ground operations to help the manage disaster relief activities. The requirements for this aircraft are listed below and during the development of the project they must be respected. Possible changes in the requirements will be discussed and agreed upon by the teacher and all the elements involved in the project.

It is required to perform the conceptual and preliminary design of this UAV taking into

account some specific design requirements. The aircraft must have good flying qualities to allow easy and precise flying. The vehicle's structure and aerodynamics must be carefully designed to achieve low power consumption levels. Simplicity, robustness, and ease of repair are essential to maintain high levels of operational readiness of the UAV.

9.1. Mission

The objective of the operation is to provide support in an earthquake scenario occurring in an urban area. The operation must ensure rapid response, continuous situational assessment, and support to emergency teams through a UAV capable of rapidly reaching the affected zone, producing real-time aerial mapping, identifying blocked routes, victims in isolated areas, and secondary hazards, and maintaining prolonged surveillance (loitering). The UAV must fly to the affected region from a central operations base located away from it. Once on site, it must be able to quickly map large areas, detect victims or thermal hotspots, continuously monitor the situation, relay communications between teams on the ground, safely operate beyond visual line of sight (BVLOS), and record all data for post-analysis. The mission must be performed automatically, but remote piloting should be possible if required.

The UAV must be designed for the following mission profile: vertical take-off; transition to horizontal flight; climb to a cruise altitude between 150 m and 400 m; cruise for 25 km to reach the surveillance area; perform on-site mapping for 20 minutes around the disaster zone; loiter for 3 hours at 150 m altitude, acquiring ground imagery, heat signatures, and other relevant data; cruise back to base; and perform a vertical landing.

It is desirable, though not mandatory, for the vehicle to be able to complete the mission multiple times per day. A centrally located base is available from which the vehicle operates and to which it returns at the end of each mission. Turnaround time between missions should not exceed 15 minutes to allow for urgent flights in adverse weather conditions or during difficult operational scenarios.

The vehicle should be able to be disassembled into at least three spanwise segments.

9.2. Performance

The vehicle must show the following performance figures (ISA – *International Standard Atmosphere* conditions):

Take-off	vertical take-off
Cruise speed	around 130 km/h
Loiter speed	around 70 km/h
Range	250 km
Flight operational radius	at least 30 km
Data link range	at least 80 km (line-of-sight)
Operational ceiling	at least 1000 m
Landing	vertical landing

9.3. Propulsion

The aircraft can use piston or electric motors or even a hybrid propulsion arrangement. Batteries for energy storage and solar cells for energy harvesting can be used. Up to two motors and up to two propellers may be used. In selecting the engine(s) and/or motor(s), careful attention must be given to its durability and reliability. Proper cooling must be provided. Propellers must be fixed pitch. The propellers must be selected according to the engine/motor

performance and UAV flight conditions required. The aircraft can have a tractor or pusher propeller configuration or even a combination of both. Thrust vectoring can be used for vertical flight operations. The design shall be fault tolerant: able to continue to fly safely and land having suffered a failure of a single motor, battery, or propeller.

Batteries shall have a specific energy of not more than 250 Wh/kg at the cell level and a value of not more than 200 Wh/kg for the cells integrated into packs, including monitoring, control, and cooling.

9.4. Wings

The aircraft shall have a fixed wing configuration, with a maximum wingspan of 4 m. The wings must be well designed, both aerodynamically and structurally, so that the overall efficiency of the vehicle is high and to allow the required mission to be accomplished with low energy requirements. According to the mission, the wings can be designed for high lift-to-drag ratio. The structure should be as simple as possible and use high impact-resistant light materials to ease repair in the case of accidents and to allow for an empty weight as low as possible.

9.5. Fuselage

The fuselage should be slender, and light yet possess the necessary internal space for systems, batteries, and payload. Equipment substitution and payload access should be quick and simple to perform. The fuselage shape can be smoothly blended with the wing. The payload compartment(s) should be capable of carrying the mission payload equipment.

9.6. Tail

The tail, when present, must be small and effective. It should use in their structure the same materials selected for the wings. Proper stability and control should be guaranteed by the tail design.

9.7. Landing Gear

The landing gear, if used, should be as simple and compact as possible.

9.8. Payload

The payload (up to 3.5 kg) must be well secured in the fuselage to avoid any movement during flight. The mission payload includes a stabilized EO/IR gimbal for day-and-night imaging, a lightweight LiDAR module for 3D terrain mapping, a high-precision IMU and RTK-enabled GNSS unit for accurate georeferencing, a long-range BVLOS communication system with dedicated antennas, an optional mesh-network radio repeater for supporting ground teams, an onboard processing unit for data recording and real-time AI analysis, safety-critical navigation sensors such as an altimeter and ADS-B receiver, and a small suite of environmental sensors for monitoring temperature, humidity, smoke, or gas levels..

9.9. Weight and Balance

A Maximum Take-off Mass (MTOM) of 25 kg is mandatory. The centre of gravity (CG) travel must be such that no negative impact on the stability or on the normal operation of the

aircraft is imposed. It is important that the maximum take-off mass of the aircraft is kept as low as possible.

9.10. Controls and Systems

The control system will include autopilot boards that can perform automatic navigation and control of the UAV for a predefined mission profile. A receiver must also be installed for remote piloting from the ground. Control surfaces must be sized and must be actuated by servo mechanisms. The aircraft must be aerodynamically stable in all axes. Artificial stability systems may not be used to enhance an otherwise aerodynamically unstable aircraft.

All electronic and electric components and mission equipment must be placed within the fuselage or wings according to their function and in such a way as to allow its quick preparation or replacement. The electric system should be powered by batteries and a generator.

9.11. Design Airworthiness Requirements

The design airworthiness requirements that should be used in the structural sizing are the EASA CS-LSA, CS-VLA or CS-23. The design manoeuvre limit load factors are +2 and -2, but those should be checked with a V-n diagram appropriate for the selected regulations. All work performed in the design should aim at achieving high levels of safety and performance.

10. TASKS

There are several tasks in the design project that must be carried out according to the time plan below. All tasks depend on each other so that there must be a close interaction and updating between them. The design process is also iterative in nature, but perfection is not possible nor is necessary, but an effort must be put forward to achieve a good optimization level in the outcome.

The necessary calculations may be performed with the help of spread sheets and other analysis computer programs. All drawings should be developed in CATIA V5 or similar.

10.1. Concept of Operations

The exact mission profile and the way it is going to be operationally implemented must be defined and explained. The design of the vehicle will follow from the concept of operations (CONOPS) proposed to respond to the mission requirements.

10.2. Layout

The layout and functionalities of the vehicle must be selected so that the requirements are fully met. This task is very important because it integrates all needs of the other parts of the project into a viable configuration: aerodynamic/stability, propulsion/performance, structure/materials and systems/costs aspects should be addressed. A preliminary three-dimensional (3D) study of all major components must be performed, and these must be incorporated in the aircraft structure. 3D drawings must be produced in a CAD system for the complete UAV.

10.3. Aerodynamics and Stability

The aerodynamic study must cover the selection of the aerofoils, geometry and size of the lifting surfaces, controls, nacelles, and the computation of the aerodynamic characteristics of the whole vehicle (C_L, C_D e C_M). It must be assured that all choices made in the overall design do not impair the aerodynamic performance. A study of the stability and control of the UAV must also be performed.

The aerodynamics work must concentrate on the wings design and tail sizing. These must be optimized having in mind the necessary compromises for different flight conditions.

10.4. Propulsion and Performance

The propulsive system(s) (motors, propellers, power source) must be selected and sized according to the requirements. An estimate of the vehicle's main performance figures (range, endurance, rate of climb, ceiling, speeds) and mission performance (speeds, times, fuel and/or battery energy usage, etc.) must be carried out.

10.5. Structure and Materials

The type of structure and materials for the different components of the vehicle must be selected and thoroughly defined keeping in mind their configuration and function. Connections among components and assembling/disassembling requirements must be devised. The V-n diagram needs to be determined. Preliminary sizing of the wing should be addressed. A database containing such data as suppliers, physical characteristics, mechanical characteristics, and price of all materials selected must be produced.

10.6. Systems and CG

A study of the landing gear system (if it exists), of the control system and of the electric system must be performed. These studies should include not only the selection of the main components and definition of its functionalities but also the positioning of components and cables routing inside the aircraft. Commercially available components are preferred to speed up both design and building processes. A database containing such data as suppliers, working characteristics, mass, power consumption and price of all selected components must be produced. Estimates of weight and balance must also be performed.

10.7. Manufacturing and Costs

A study on the manufacturing processes to be used in the main structural components needs to be carried out. An estimate of the total cost of the UAV, based on the materials and systems used and the number of units to be produced should be obtained.

10.8. Operations and Costs

Based on the proposed CONOPS, one or more operational scenarios for an operator to use the designed UAV or a fleet of several UAVs should be devised together with estimates of the costs and gains associated with those operational scenarios.

10.9. Structural Sizing

Preliminary sizing of the main components (wings, tails, fuselage and landing gear) is to be performed based on the structural concepts proposed in the Structure and Materials task, using Finite element analysis (FEA) tools.

10.10. Time plan

The table below presents the time plan with the tasks required to complete de project.

Month	F	F	M	M	M	M	A	A	A	A	A	M	M	M	M	J	J	J	J	J
Task \ Week	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Lectures																				
Concept of operations																				
Layout																				
Aerodynamics/Stability																				
Propulsion/Performance																				
Structure/Materials																				
Systems																				
Manufacturing/Costs																				
Operations/Costs																				
Structural Sizing																				
Test																01				
Presentations				13								04				05	08			
Report																	09			
Exams																				

Legend:
- Lectures
- Design work
- Weeks without lectures
- Assessment

10.11. Design Teams

The design is carried out by groups of 5 students who need to perform mandatory tasks 1 to 6. If groups have 6 students one additional task from tasks 7 to 9 must be selected. All students should work hard for the project objectives to be fulfilled on time.

	Student's Name	Nº	Team	E-mail	Task
			A		layout
			A		aerodynamics/stability
			A		propulsion/performance
			A		structures/materials
			A		systems/CG
			B		layout
			B		aerodynamics/stability
			B		propulsion/performance
			B		structures/materials
			B		systems/CG
			C		layout
			C		aerodynamics/stability
			C		propulsion/performance
			C		structures/materials
			C		systems/CG

			D		layout
			D		aerodynamics/stability
			D		propulsion/performance
			D		structures/materials
			D		systems/CG
			E		layout
			E		aerodynamics/stability
			E		propulsion/performance
			E		structures/materials
			E		systems/CG
			F		layout
			F		aerodynamics/stability
			F		propulsion/performance
			F		structures/materials
			F		systems/CG
			G		layout
			G		aerodynamics/stability
			G		propulsion/performance
			G		structures/materials
			G		systems/CG
			H		layout
			H		aerodynamics/stability
			H		propulsion/performance
			H		structures/materials
			H		systems/CG
			I		layout
			I		aerodynamics/stability
			I		propulsion/performance
			I		structures/materials
			I		systems/CG
			J		layout
			J		aerodynamics/stability
			J		propulsion/performance
			J		structures/materials
			J		systems/CG

11. ASSESSMENT

The grade of this subject is given based on one written test (T), three oral presentations (P) and one report (R).

11.1. Test

The test covers all the topics discussed during classes up to the date of the test (01 June 2026, week 16). The test is divided into two parts: the first is closed book and the second is open book.

11.2. Presentations

There will be 3 oral presentations: one for the concept of operations (13 March 2026 – week 4); one for the conceptual design (4 May 2026 – week 12); and one for the complete design (5 & 8 June 2026 – weeks 16 & 17). In the presentations, each design team (all elements of the team must participate in the presentations) must describe its concepts, design philosophy, analyses, and results. The first and second presentations should take only 10 minutes each while the last presentation should take 20 minutes, depending on the number of teams. The presentation files in *pdf* format should be forwarded to the professor (pgamboa@ubi.pt) at the end of each presentation session.

All presentations will be assessed based on:

- Oral expression and quality of the information on the slides.
- Relevance and scope of the presented information.
- Objectivity and coherence of the discussed topics.
- Adequate understanding of the discussed matters and knowledge of the design.
- Technical content.
- Replies to audience questions.
- Usage of the available time.

11.3. Report

Each team must write up a design report that should contain all relevant steps taken in the aircraft design process. A typical structure of the report would include the following:

- Introduction: presentation of the requirements, the objectives of the design, and the team members' tasks.
- Concept of operations: presentation of the concept of operations devised to perform the mission.
- Conceptual Design: short description of the state-of-the-art relevant to the design, initial sizing based on the state-of-the-art, description and justification of the main features and innovations in the design – layout, aerodynamics, propulsion, structure and systems concepts (drawings should be used to illustrate these concepts).
- Preliminary Design: presentation of analyses and sizing – aerodynamics and stability properties; propulsion and performance estimates; structural, weight and balance calculations (mass breakdown of the aircraft, including reasonable estimates for each major component); systems integration in the airframe; cost analysis; optimization studies; manufacturing considerations; and operations costs – and three-view general arrangement drawing of the design with all relevant dimensions and a table with the major aircraft characteristics.
- Conclusions: summary of design outcomes based on the objectives.
- References: list of literature sources used in the report.
- Appendices: presentation of complementary data, drawings, and analyses.

The number of pages is limited to around 30, using letter size 10-12, depending on letter type, single line spacing and 20 mm left and right margins. The report in *pdf* format should be forwarded to the professor (pgamboa@ubi.pt) at the last day of lectures (09 June 2026 – week 17).

If students submit a revised report in the exam periods (*Época Normal* and/or *Época de Recurso*), they must add a Preamble section before the Introduction listing the corrections/additions to the report/project since the previous report indicating the sections and pages that have been modified.

11.4. Exam

There will be no written exam. If students fail the "Frequência" assessment or wish to improve their final grade, they must hand in an improved report of their design project at the dates of the exam, in weeks 18 and/or 20.

11.5. Grade

The mark of this subject is given by F = 0.3T + 0.2P + 0.5R and approval is obtained if F ≥ 10. The same is true for the exam final mark.

1.		Frequência (F = 0.3T + 0.2P + 0.5R)		100
	T	Test	01-06-2026	30
	P	Presentations	13-03-2026 ; 04-05-2026 ; 05 & 08-06-2026	20
	R	Report	09-06-2026 (24h00)	50
2.		Exam (E = 0.3T + 0.2P +0.5 R1)		100
	R1	Report (*época normal*)	??-06-2026 (??h30)	50
	R1	Report (*época recurso*)	??-07-2026 (??h30)	50
3.		Exam (E = 0.3T + 0.2P +0.5 R2)		100
	R2	Report (*época especial*)	??-07-2026 (??h30)	50

12. BIBLIOGRAPHY

The books listed below can be used for the design. The design reports of previous years may also be useful as general guideline and source of ideas. However, one must bear in mind that the information contained in them may be incorrect. A lot of information can also be found on the internet using appropriate search criteria.

12.1. Notes

00. Gamboa. P.V., Apontamentos de Projeto de Aeronaves, ~600 acetatos, UBI, 2024

12.2. Textbook

01. Raymer, D. P., *Aircraft Design: A Conceptual Approach* – 5th edition, AIAA Education Series, 2012

12.3. Aircraft Design Books

02. Gudmundsson, S., *General Aviation Aircraft Design: Applied Methods and Procedures*, Elsevier, 2014.
03. Torenbeek, E., *Advanced Aircraft Design: Conceptual Design, Analysis and Optimization of Subsonic Civil Airplanes*, Hoboken, New Jersey: John Wiley & Sons, 2013.
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05. Jenkinson, Lloyd R., Marchman III, James F., *Aircraft Design Projects for Engineering Students*, Butterworth-Heinemann, 2003
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10. Roskam, J., *Airplane Design* – Volumes I to VIII, The University of Kansas, 1990
11. Stinton, D., *The Design of the Aeroplane*, Blackwell Science, 1983
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14. Pazmany, L., *Light Airplane Design*, Pazmany Aircraft Corporation, 1963

12.4. Other Books

15. Abbot & Doenhoff, *Theory of Wing Sections*, Dover Publications Inc, 1959
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17. Barnes W. McCormick, *Aerodynamics, Aeronautics and Flight Mechanics* – 2nd edition, John Wiley & Sons Inc, 1995
18. Bernard Etkin, Lloyd Duff Reid, *Dynamics of Flight, Stability and Control* – 3rd edition, John Wiley & Sons Inc., 1996
19. Bill Clarke, *The Cessna 172* – 2nd edition, Tab Books, 1993
20. Darrol Stinton, *Flying Qualities and Flight Testing of the Airplane*, AIAA Education Series, 1996
21. David A. Lombardo, *Aircraft Systems –Understanding Your Airplane*, Tab Books, 1988
22. Euroavia, *Future Trainer Concept*, 1999
23. Geoff Jones, *Building and Flying Your Own Plane*, Patrick Stephens Limited, 1992
24. Ian Moir & Allan Seabridge, *Aircraft Systems*, Longman Scientific & Technical, 1992
25. *Jane's All the World Aircraft*, 1995
26. Certification Specifications for Light Sport Aeroplanes (CS-LSA), Initial Airworthiness, EASA, 2011, and Amendment 1 (2013)
27. Certification Specifications for Very Light Aeroplanes (CS-VLA), Initial Airworthiness, EASA, 2003, and Amendments 1 to 5 (2009 to 2017)
28. Certification Specifications for Normal, Utility, Aerobatic and Commuter Aeroplanes (CS-23), Initial Airworthiness, EASA, 2003, and Amendments 1 to 5 (2009 to 2020)
29. Ladislao Pazmany, *Landing Gear Design for Light Aircraft* – Volumes I & II, Pazmany Aircraft Corporation, 1986
30. John Cutler, *Understanding Aircraft Structures*, Blackwell Science, 1999
31. Martín Cuesta Alvarez, *Vuelo con Motor Alternativo*, Paraninfo, 1981
32. Robert C. Nelson, *Flight Stability and Automatic Control*, McGraw-Hill, 1989
33. S. Hoerner, *Fluid-Dynamic Drag, Hoerner Fluid Dynamics*, 1965
34. S. Hoerner, *Fluid-Dynamic Lift, Hoerner Fluid Dynamics*, 2nd Edition, 1985
35. Stelio Frati, *L'Aliante*, Editore Ulrico Hoepli, Milano, 1946
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