UNIVERSITÀ DEGLI STUDI DI PALERMO

SCHOOL	POLYTECHNIC SCHOOL
ACADEMIC YEAR	2016/2017
SECOND CYCLE (7TH LEVEL) COURSE	AEROSPACE ENGINEERING
SUBJECT	AIRCRAFT AND SYSTEMS DESIGN
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50350-Ingegneria aerospaziale ed astronautica
CODE	16951
SCIENTIFIC SECTOR(S)	ING-IND/04
HEAD PROFESSOR(S)	BENEDETTI IVANO Ricercatore Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BENEDETTI IVANO** Monday 14:30 16:30 Ufficio Docente Tuesday 14:30 16:30 Ufficio Docente

DOCENTE: Prof. IVANO BENEDETTI

TEACHING METHODS	Frontal lectures and class practicals.
ASSESSMENT METHODS	Oral exam: it will assess the comprehension of the topics covered by the lectures and of the exercises developed during the practicals. The questions (input), either open or semi-structured, will be devoted to the assessment of: 1) Acquired knowledge; 2) Elaboration skills; 3) Presentation skills. Acquired knowledge: the exam will assess the ability to describe, critically and quantitatively, the different aircraft systems and components and the ability to describe the iterative process of aircraft design; Elaboration skills: the exam will also assess the student's ability to critically link the different topics of the course and to estimate the effects of different choices on the design of the aircraft, conceived as a complex system. Moreover, the exam will assess the independent thinking of the students, through questions and exercises aimed at inducing an autonomous elaboration, beyond the exercises developed in the class' practicals. Presentation skills: the exam will assess the ability of the students to describe the aircraft systems and components, and their interatcions, with accurate and articulate language. The highest score will be obtained by students able to describe, with accurate and articulate language, the different components and systems of the aircraft, as well as their interactions, using the analytical tools presented during the course and demonstrating independent thinking skills with respect to the technical questions presented during the exam. An intermediate score will be obtained by students who prove good comprehension of the course topics and appropriate technical language, but show little independent thinking abilities. The minimum score will be obtained by students who show a sufficient but limited comprehension of the course topics, with appropriate but scarcely articulate technical language, and little or no independent thinking attitude.
LEARNING OUTCOMES	Knowledge and comprehension • Knowledge and comprehension of the technical and economic factors leading to the development of a new aircraft. • Knowledge of the techniques for the general design of an aircraft, from the conceptual design to the initial sizing, weights distribution and systems layout. • Knowledge of the functionality, operation principles, varieties and features of the main aircraft systems . • Knowledge of the main methods for the analysis of the oleodynamic, electric, pneumatic and fuel systems, for the landing system, control surfaces, hazards protection systems and avionics. Ability to use knowledge and comprehension • Application of the main techniques for the initial sizing of an aircraft; • Application of advanced analytical methods for the estimation of the main parameters of the different aircraft systems. Independent thinking • Ability to identify the main parameters for the initial sizing of an aircraft; • Ability to identify problematic aspects in aircraft systems and to use the acquired knowledge to develop advanced systemic approaches. Presentation skills • Ability to present, through technical reports, specific design choices and results of technical investigations about the operation of aircraft systems. • Development of team communication skills. Learning ability • The student will acquire the technical ability and maturity that will allow to deepen specific topics, related to the general design of aircrafts and systems, through access to technical and scientific literature.
EDUCATIONAL OBJECTIVES	• The objective of the course is to introduce the students to the techniques used for the initial sizing of the aircraft and its systems, with reference to the technical and economic factors affecting the development of a new project.

	• The student will acquire the skills needed for the conceptual design of the aircraft with reference to its mission profile, for the initial sizing, the selection of aerodynamic features and wing loading, the systems layout and weights distribution. • For each system, the operation principles will be described and the anlytical tools for the initiial sizing will be given. The basic physical principles will be discussed as well as their mathematical modelling. The practicals will introduce the students to the use of software tools for the initial sizing and analysis of aircarft components and systems.
PREREQUISITES	The following are considered requirements for the optimal completion of the class and the attainment of the course objectives: - Fundamentals of flight mechanics; - Fundamentals of aerodynamics; - Fundamentals of structural mechanics; - Fundamentals of fluid mechanics and thermodynamics.
SUGGESTED BIBLIOGRAPHY	Materiale didattico: • Presentazioni del corso; Testi consigliati: • Daniel P. Raymer - Aircraft Design: A Conceptual Approach - AIAA Education Series; Testi di approfondimento: • M.H. Sadraey - Aircraft Design: A systems engineering approach - Wiley Aerospace Series • Snorri Gudmundsson - General Aviation Aircraft Design: Applied Methods and Procedures - Butterworth-Heinemann • J. P. Fielding - Introduction to Aircraft Design - Cambridge University Press. • D.A. Lombardo, Aircraft systems, Mc Graw-Hill • D.A. Lombardo, Advanced Aircraft systems, Mc Graw-Hill • Helfrick, Principles of Avionics, Avionics Communications Inc. • N.D. Manring, Hydraulic control systems, Wiley

SYLLABUS

Hrs	Frontal teaching
1	Introduction to aircraft design, aircraft systems and to the factors affecting the development of a new aircarft.
2	Initial sizing from conceptual design: mission profile and determination of the Maximum Take-Off Weight.
4	Selection of the wing loading and thrust-to-weight ratio on the basis of the required performances.
3	Initial sizing based on maximum take-off weight, wing loading, thrust-to-weight ratio: use of empirical and statistical data for the initial sizing of the wing, fuselage and tail.
3	Aerodynamic features and selection of the wing geometry.
3	Tail design.
4	Fuselage design: functions and requirements. Pneumatic system: pressurization and air conditioning, functions and operation principles, features and components.
4	Propulsion and fuel systems: functions, operation principles, classification and features, components and integration.
4	Landing gear: functions, operation principles, classification and features, components and integration.
3	Weights and weights distribution.
3	Control surfaces: functions, operation principles, classification and components.
4	Oleodynamic system: functions, operation principles, classification and compoonents.
2	Electric system: functions, operation systems, classification and components.
2	Board instruments and fundamentals of avionics.
2	Environmental protection and emergency systems: functions, operation principles, classification and components.
1	Cost analysis and life cycle of an aircraft.

Hrs	Practice
3	Estimate of the maximum take-off weight on the basis of the mission profile.
6	Selection of wing loading and thrust-to-weight ratio by the technique of the matching plot.
6	Wing and tail sizing.
3	Fuselage design.
3	Propulsion and fuel system design.

Hrs	Practice
6	Landing gear design, general layout and weights distribution.
3	Pneumatic system design.
6	Integration of the design components and design iteration.