《飞行器设计》课程教学大纲

课程基本信息（Course Information）					
课程代码 （Course Code）	AV314	*学时 （Credit Hours）	48	*学分 （Credits）	3
*课程名称 （Course Name）	飞行器设计(C) Aircraft Design (C)				
课程性质 (Course Type)	Optional				
授课对象 （Audience）	Third year undergraduate				
授课语言 (Language of Instruction)	English				
*开课院系 （School）	School of Aeronautics and Astronautics				
先修课程 （Prerequisite）	Aerodynamics				
授课教师 （Instructor）	Song Wenbin	课程网址 (Course Webpage)	http://ecc.sjtu.edu.cn/html/course_134.html		
*课程简介 （Description, in Chinese）	本课程面向航空航天工程专业本科高年级学生，以民用飞机设计为重点，涵盖航空器设计的基本知识、方法和流程，内容包括气动布局与设计，重量，材料结构，性能，操稳特性，动力装置，以及适航和经济性等专业，通过课堂学习，个人作业，以及小组作业，采用多种评议方式，完成本课程后，学生应该具备飞机概念设计的基本知识和技能。				
*课程简介 （Description, in English）	This course is designed for senior undergraduate. The overall objectives of the course are to introduce students with the basic principles, methods and processes used in conceptual aircraft design, focusing on the design aspects of transport aircraft. Students are expected to attend lectures and finish individual and team projects within the schedule, and to demonstrate the ability to accomplish typical analysis tasks in the process of conceptual design, both individually and in teams. Students are also expected to present the results orally and in written report in a professional way.				
课程教学大纲（course syllabus）					

*学习目标 (Learning Outcomes)	Up completion of the subject, students will be able to: 1. Understand the basic principles, methods and processes used in conceptual and some part of the preliminary aircraft design including weight estimation, configuration analysis, fuselage design, performance calculation, engine selection, aerodynamic design, structural layout design, economic analysis, system selection and analysis, overall sizing, etc. 2. Be able to perform basic analysis and design tasks in the design process 3. Able to work effectively within a team as well as individually to solve relevant problems 4. Be able to present the results both orally and in written report					

	编号	教学内容	学时	教学方式	作业及要求	基本要求	考查方式
*教学内容、进度安排及要求 (Class Schedule & Requirements)	1	Introduction	2	Lecture			
	Course description, Requirement analysis, aircraft design process, design tasks, team work and future trend						
	2	Overall configuration	2	lecture			
	Introduce aircraft configuration including conventional and novel configurations, analysis of aircraft configurations, major components, c.g. locations, aircraft systems						
	3	Preliminary Weight estimation	2	lecture			
	Weight Components, Breguet Range Equation, SFC, Flight Profile, Take-off Weight Estimation, Empty Weight Estimation, Fuel Fraction Estimation, Weight of Structure Components, Fuel Tank Volume, C.G. of Various Component Groups						
	4	Refined Weight	2	lecture			
	Component based weight estimation methods						
	5	Fuselage design	2	Lecture			
	Passenger Cabin Layout, Fuselage Geometry, Airworthiness, Systems, Area Law, Cockpit Design						
	6	Aerodynamic design	2	lecture			
	Aircraft aerodynamic design: Airfoil, wing, fuselage, tails						
	7	Aerodynamic estimation	2	lecture			
	Lift estimation, drag estimation methods						
	8	CFD-based aerodynamic design	2	lecture			
	Geometry modeling, computational fluid dynamics methods; inverse design and numerical optimization						

	9	Thrust weight ratio and wing loading	2	Lecture			
	Thrust weight ratio estimation methods Wing loading estimation Aircraft sizing methods						
	10	Landing gear	2	lecture			
	Basic design requirements; tasks in landing gear design; landing gear arrangement; main design parameters; principles of deciding parameters; shock absorbers and geometry						
	11	Powerplant	2	lecture			
	Type of propulsion, air breathing engines, engine characteristics, engine performance, engine installation, inlet and nozzle design, fuel system						
	12	Loading, materials, and structure	2	lecture			
	Structural design requirements and criteria; loads triangle; categories of aircraft loads, evolution of design criteria; structural analysis; material selection; future trends						
	13	Stability and control	2	lecture			
	Overview, definition and types of stability; stability analysis; aircraft control systems, aircraft flying qualities;						
	14	Performance (a)	2	Lecture			
	Role of aircraft performance analysis, basic concepts and equations; take-off performance						
	15	Performance (b)	2	lecture			
	Landing performance; steady level flight; steady climbing and descending flight; level turning flight; gliding flight, other flight performance						
	16	Aircraft certification	2	lecture			
	Basic concepts and development of aircraft certification; FAR, EASA CAAC and others; examples of aircraft certification; certification types and process, aircraft noise rules, ETOPS rules						
	17	Aviation economics	2	lecture			
	Introduction, aircraft operating cost; cost of aircraft programs, passenger economics, airports, design for aircraft economics						
	18	System engineering and	2	lecture			

		configuration management					

Aircraft configuration management covering definition, plan, policies, and procedures; system integration covering distributed engineering and manufacturing; digital mock-up, virtual reality in design

| | 19 | Multidisciplinary design analysis and optimization | 2 | lecture | | | |

Introduction; basic procedures; optimization methods; engineering optimization using CAE tools; multidisciplinary design optimization; some advanced topics

| | 20 | Military aircraft design - introduction | 2 | lecture | | | |

Requirements for military aircraft; types of military aircraft; key features, military transport, unmanned aircraft, life cycle cost modeling, key technologies

| | 21 | Environmental issues | 2 | lecture | | | |

Aircraft noise; aircraft emission

| | 22 | Design skills | 2 | lecture | | | |

Covering technical skills, transferrable skills, technical writing and technical presentations

Two reviews (one in the mid-term and the other is at the end of the term) will be arranged for the students to report their work (progress) and lecturers to give specific feedbacks on the progress of the team project work.

The work and presentation will be marked by students as well as by lecturers using a standardized form.

*考核方式 (Grading)	The final score is based on assessment of individual tasks and contributions in the group tasks. The group report and presentation will be marked using a combined peer-review and tutor review method. The percentage from each part is as follows: 1. Individual task: 40%, evaluation of individual report (30%) and design flowchart (10%) 2. Team project: 60%, technical content, completeness, team work, written and oral presentation skills. No exams for the course.
*教材或参考资料 (Textbooks & Other Materials)	**Textbook:** Daniel P. Raymer, Aircraft Design: A Conceptual Approach, 5th Edition, AIAA Education Series, 2012. ISBN-13: 978-1600869112, ISBN-10: 1600869114. **Supplemental Materials** 1) Torenbeek, E., Advanced Aircraft Design: Conceptual Design, Technology and Optimization of Subsonic Civil Airplanes, 2013.

	2) Jenkinson, L.R., Simpkin, P., and Rhodes, D., Civil Jet Aircraft Design, 2003.
其它 （More）	Students are encouraged to read extensively with library and internet resources on the topic. Students wishing to pursue a career in Chinese aerospace industry should also extend their reading to learning materials in Chinese, for example. 1) 方宝瑞，飞机气动布局设计，航空工业出版社. 1997. 9787800469374。 2) 陈迎春，宋文滨，刘洪，"民机总体设计"，上海交通大学出版社，2010. ISBN:978-7-313-05628-3.
备注 （Notes）	

备注说明：

1．带*内容为必填项。

2．课程简介字数为 300-500 字；课程大纲以表述清楚教学安排为宜，字数不限。