

## 课程详述

### COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 <b>Course Title</b>	空气动力学 <b>Aerodynamics</b>				
2.	授课院系 <b>Originating Department</b>	力学与航空航天工程系 Department of Mechanics and Aerospace Engineering				
3.	课程编号 <b>Course Code</b>	MAE405				
4.	课程学分 <b>Credit Value</b>	3				
5.	课程类别 <b>Course Type</b>	专业选修课 Major Elective Courses				
6.	授课学期 <b>Semester</b>	秋季 Fall				
7.	授课语言 <b>Teaching Language</b>	中英双语 English & Chinese				
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	王建春 力学与航空航天工程系 wangjc@sustech.edu.cn Wang Jianchun Department of Mechanics and Aerospace Engineering wangjc@sustech.edu.cn				
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced				
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>					
11.	授课方式 <b>Delivery Method</b>	讲授 <b>Lectures</b>	习题/辅导/讨论 <b>Tutorials</b>	实验/实习 <b>Lab/Practical</b>	其它(请具体注明) <b>Other (Please specify)</b>	总学时 <b>Total</b>
	学时数 <b>Credit Hours</b>	48	0	0	0	48

12. 先修课程、其它学习要求 <b>Pre-requisites or Other Academic Requirements</b>	高等数学（下）A 或者 数学分析 II 或者 高等数学（下） Calculus II A or Mathematical Analysis II or Calculus II
13. 后续课程、其它学习规划 <b>Courses for which this course is a pre-requisite</b>	无 NA
14. 其它要求修读本课程的学系 <b>Cross-listing Dept.</b>	无 NA

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

空气动力学是力学类本科生的专业选修课。目标是培养学生系统掌握空气动力学的科学概念、基本理论，以及解决空气动力学问题的基本方法和分析手段。本课程的基本内容包括空气动力学的基本概念、低速流动的基本原理、绕机翼的不可压缩流动的基本理论、可压缩流动的激波和膨胀波理论等。

The course includes fundamental principles of aerodynamics, fundamentals of incompressible flow, incompressible flow over airfoils, and, theory of shock waves and expansion waves in compressible flow.

#### 16. 预达学习成果 Learning Outcomes

空气动力学的基本知识在航空领域中有着广泛的应用。通过本课程的学习，让学生了解空气动力学的学科分类和应用范围、空气动力学的基本参数、不可压缩无粘流动的基本理论、薄翼理论、升力线理论等。空气动力学教学对学生思维方法的训练，分析与解决问题能力的提高和综合素质的培养，都有重要的意义。

To develop a conceptual understanding of the core concepts, and an ability to apply the theoretical framework to describe and predict the aerodynamic forces on bodies moving through a fluid and determinate flow properties around bodies.

#### 17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人） **Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)**

Section 1: 空气动力学基本变量，气动力和力矩，压力中心；量纲分析，流动相似性（3 学时）

Section 2: 流动的类型；连续方程，动量方程，能量方程（3 学时）

Section 3: 流函数，速度势；伯努利方程（3 学时）

Section 4: 拉普拉斯方程；均匀流、源流（3 学时）

Section 5: 偶极子和点涡；绕圆柱的流动（3 学时）

Section 6: 库塔-儒可夫斯基定理和升力的产生（3 学时）

Section 7: 翼型的术语和特征参数；涡面（3 学时）

Section 8: 库塔条件（3 学时）

Section 9: 经典薄翼理论：对称翼型和有弯度翼型（3 学时）

Section 10: 涡板块数值方法（3 学时）

Section 11: 下洗和诱导阻力；涡丝，毕奥-萨瓦定理和亥姆霍兹定理（3 学时）

Section 12: 普朗特经典升力线理论 (3 学时)

Section 13: 可压缩流动控制方程; 激波 (3 学时)

Section 14: 正激波特性的计算 (3 学时)

Section 15: 斜激波 (3 学时)

Section 16: 膨胀波 (3 学时)

Section 1: Some fundamental aerodynamic variables; Aerodynamic force and moment; Center of pressure; Dimensional analysis and flow similarity (3 credit hours)

Section 2: Types of flow; Continuity equation; Momentum equation; Energy equation (3 credit hours)

Section 3: Stream function; Velocity potential; Bernoulli's equation (3 credit hours)

Section 4: Laplace's equation; Uniform flow; Source flow (3 credit hours)

Section 5: Doublet flow; Flow over a circular cylinder (3 credit hours)

Section 6: The Kutta-Joukowski theorem and the generation of lift (3 credit hours)

Section 7: Nomenclature and characteristics of airfoil; The vortex sheet (3 credit hours)

Section 8: The Kutta condition (3 credit hours)

Section 9: Classical thin airfoil theory: the symmetric airfoil and cambered airfoil (3 credit hours)

Section 10: The vortex panel numerical method (3 credit hours)

Section 11: Downwash and induced drag; The vortex filament, the Biot-Savart law and Helmholtz's theorems (3 credit hours)

Section 12: Prandtl's classical lifting-line theory (3 credit hours)

Section 13: Governing equations of compressible flow; Shock waves (3 credit hours)

Section 14: Calculation of normal shock-wave properties (3 credit hours)

Section 15: Oblique shock waves (3 credit hours)

Section 16: Expansion waves (3 credit hours)

18. 教材及其它参考资料 Textbook and Supplementary Readings

教材 (Textbook) :

[1] John D. Anderson, Jr, Fundamentals of Aerodynamics, 5th edition, Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, 2009

[2] 小约翰·D·安德森 (John D. Anderson, Jr.) 著, 杨永等译注, 空气动力学基础 (双语教学译注版), 航空工业出版社, 2014

参考书目 (Supplementary Readings) :

[1] 钱翼稷编著, 空气动力学, 北京航空航天大学出版社, 2004 年

[2] 童秉纲等编著, 气体动力学, 高等教育出版社, 2012 年

### 课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance		5	作弊记 0 分 Cheating: 0	
小测验 Quiz		10	作弊记 0 分 Cheating: 0	
课程项目 Projects				
平时作业 Assignments		15	作弊记 0 分 Cheating: 0	
期中考试 Mid-Term Test		30	作弊记 0 分 Cheating: 0	
期末考试 Final Exam		40	作弊记 0 分 Cheating: 0	
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方 式) Others (The above may be modified as necessary)				

### 20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading  
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

### 课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过  
 This Course has been approved by the following person or committee of authority

力学与航空航天工程系教学指导委员会

The commission of teaching instruction in department of mechanics and aerospace engineering

