

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 Course Title	航空发动机结构与强度 Aero Engine Structure and Strength				
2.	授课院系 Originating Department	力学与航空航天工程系 Department of Mechanics and Aerospace Engineering				
3.	课程编号 Course Code	MAE313				
4.	课程学分 Credit Value	3 (含 1 实验学分)				
5.	课程类别 Course Type	专业选修课 Major Elective Courses				
6.	授课学期 Semester	秋季 Fall				
7.	授课语言 Teaching Language	英文 English				
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) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	韩品连 Han Pinlian, 力学与航空航天工程系, Department of Mechanics and Aerospace Engineering Mobile: 18928441653 Email: hanpl@sustech.edu.cn				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	学时数 Credit Hours	32		32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 NA
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 NA
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 NA

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

• 研讨先进航空发动机的结构与强度的主要问题，简单介绍先进航空发动机的设计、制造以及发展趋势和挑战，内容包括航空管理局（如美国联邦航空管理局）对发动机的要求和发动机各单元体的构型和结构。学生将会获得下列方面的知识：

- 1) 航空发动机的基本原理和结构特点
- 2) 现在和将来对产品的主要关注点是什么；
- 3) 如何分析和解决安全性、可靠性及环境问题。

• 学生通过课堂和实验室的学习了解发动机和结构完整性的基本要求，知道如何通过恰当的工具分析并评估一个航空发动机，以及如何成为一名胜任的工程师。

• Introduction and discussion of the structure and integrity of the advanced aero engines, including a brief introduction of the design, manufacture of the engine, the challenge of all major engine units/parts, as well as the requirements of airworthy authority like FAA (Federal Aviation Administration).

• Students shall understand the basic requirements of structure integrity, the principles and the structures of the engine, and the major concerns of the product. By the module and lab teaching, students shall know how people analyse and solve those problems related to safety, reliability and environment, how to analysis and evaluate an aero engine, how to find the right tool to do the job, as well as how to become a qualified engineer.

16. 预达学习成果 Learning Outcomes

学生应该了解航空发动机的基本原理和结构特点，理解结构完整性要求，以及怎样分析、评估一台飞机发动机，同时能够使用正确的工具来完成工作。

Students shall understand the basic principles and structural requirements of the engine, including structure integrity, and how to analysis and evaluate the aero engine performance, as well as to find the right tool to accomplish the job

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.)

<p>Lesson 1 (2 Credit Hours)</p>	<p>航空发动机概论: (2 学时) 航空发动机历史、现状、发展趋势以及面临的挑战 An Introduction to Aero Engine: (2 Credit Hours) The History, Current State of Aero Engine, Future Trends and the Challenges</p>
<p>Lesson 2 (6 Credit Hours)</p>	<p>航空发动机概论: (2 学时) 航空发动机原理 (热力学定律、布雷登循环、活塞式发动机、涡扇发动机、涡喷发动机、涡轴发动机、涡浆发动机等) An Introduction to Aero Engine: (2 Credit Hours) Engine Principle (Law of Thermodynamics, Brayton Cycle, Reciprocating Engine, Turbofan Engine, Turbojet Engine, Turboshift Engine, Propeller Engine, etc.) 增材制造相关工具使用 (实验课) (4 学时) 3D 打印机、打印材料。 Tools of Additive Manufacturing (Experimental Lesson): (4 Credit Hours) 3D Printing, Materials</p>
<p>Lesson 3 (2 Credit Hours)</p>	<p>航空发动机基本结构综述: (2 学时) 包括热端部件, 冷端部件, 静止件, 旋转件, 流道, 供油, 润滑, 机械传动等: An Introduction to Aero Engine Structure: (2 Credit Hours) Hot section, Cold section, Static and rotating parts, Gas path, Fuel supply and lubrication, Mechanical transmission, etc.</p>
<p>Lesson 4 (6 Credit Hours)</p>	<p>力学与运用基础: (2 学时) 破坏机制、载荷与约束 The Fundamental of Mechanics and Application: (2 Credit Hours) Failure Mechanism, Load and Constraint 增材制造相关工具使用 (实验课) (4 学时) 3D 打印机、打印材料。 Tools of Additive Manufacturing (Experimental Lesson): (4 Credit Hours) 3D Printing, Materials</p>
<p>Lesson 5 (2 Credit Hours)</p>	<p>力学与运用基础: (2 学时) 振动与疲劳、安全与寿命 The Fundamental of Mechanics and Application: (2 Credit Hours) Vibration and Fatigue, Safety and Life Tensile Stress Experiment, Rotor balance</p>

<p>Lesson 6 (6 Credit Hours)</p>	<p>航空发动机基本结构完整性综述: (2 学时) 对象、范畴、FAA 试航标准 An Overview of Aero Engine Structure Integrity, Including: (2 Credit Hours) Object, Scope, FAA Code 实验室实践 (实验课) (4 学时) 拉伸实验,转子动平衡 Sample Experiment (Experimental Lesson): (4 Credit Hours) Tensile Stress Experiment, Rotor balance</p>
<p>Lesson 7 (2 Credit Hours)</p>	<p>航空发动机主要零部件的结构完整性要求: (2 学时) 涡轮 The Structure Integrity Requirements of the Key parts of Aero Engine: (2 Credit Hours) Turbine</p>
<p>Lesson 8 (6 Credit Hours)</p>	<p>航空发动机主要零部件的结构完整性要求: (2 学时) 燃烧室 The Structure Integrity Requirements of the Key parts of Aero Engine: (2 Credit Hours) Combustor 实验室实践 (实验课) (4 学时) 拉伸实验,转子动平衡 Sample Experiment (Experimental Lesson): (4 Credit Hours) Tensile Stress Experiment, Rotor balance</p>
<p>Lesson 9 (2 Credit Hours)</p>	<p>航空发动机主要零部件的结构完整性要求: (2 学时) 燃烧室 The Structure Integrity Requirements of the Key parts of Aero Engine: (2 Credit Hours) Combustor</p>
<p>Lesson 10 (6 Credit Hours)</p>	<p>航空发动机主要零部件的结构完整性要求: (2 学时) 燃烧室 The Structure Integrity Requirements of the Key parts of Aero Engine: (2 Credit Hours) Combustor 实验室实践 (实验课) (4 学时) 有限元强度分析 Finite Element Analysis using ANSYS: (4 Credit Hours) Strength analysis</p>

<p>Lesson 11 (2 Credit Hours)</p>	<p>航空发动机主要零部件的结构完整性要求: (2 学时) 转轴、其他 The Structure Integrity Requirement of the Key parts of Aero Engine: (2 Credit Hours) Spindle, etc.</p>
<p>Lesson 12 (6 Credit Hours)</p>	<p>未来的做法: (2 学时) 被动到主动、大数据的应用、多场全覆盖监测 Future Work: (2 Credit Hours) From Passive to Active, Big Data, Multi-field Full Coverage Monitoring 实验室实践 (实验课) (4 学时) 有限元强度分析 Finite Element Analysis using ANSYS: (4 Credit Hours) Strength analysis</p>
<p>Lesson 13 (2 Credit Hours)</p>	<p>未来的做法: (2 学时) 被动到主动、大数据的应用、多场全覆盖监测 Future Work: (2 Credit Hours) From Passive to Active, Big Data, Multi-field Full Coverage Monitoring</p>
<p>Lesson 14 (6 Credit Hours)</p>	<p>增材设计能带来哪些改进: (2 学时) 微观到宏观、材料到结构 The Advances Added by Additive Design: (2 Credit Hours) From Micro to Macro, From Material to Structure. 实验室实践 (实验课) (4 学时) 有限元振动模态分析 Finite Element Analysis using ANSYS: (4 Credit Hours) Modal analysis</p>
<p>Lesson 15 (2 Credit Hours)</p>	<p>增材设计能带来哪些改进: (2 学时) 亚表面孔状结构工程力学 The Advances Added by Additive Design: (2 Credit Hours) Engineering Mechanics of Sub-surface Porous Structure</p>
<p>Lesson 16 (6 Credit Hours)</p>	<p>增材设计能带来哪些改进: (2 学时) 亚表面孔状结构工程力学 The Advances Added by Additive Design: (2 Credit Hours)</p>

	<p>Engineering Mechanics of Sub-surface Porous Structure</p> <p>实验室实践（实验课）（4 学时）</p> <p>有限元振动模态分析</p> <p>Finite Element Analysis using ANSYS: (4 Credit Hours)</p> <p>Modal analysis</p>
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18. 教材及其它参考资料 Textbook and Supplementary Readings

Norman Davey, "The Gas Turbine-Development and Engineering", Wexford College Press, May 1st, 2003.

Irwin E Treager, "Aircraft Gas Turbine Engine Technology", 3rd Edition, McGraw-Hill Education, November 13rd, 1995.

"The Jet Engine", 5th Edition, Rolls-Royce, Wiley.

Peter Spittle, "Gas Turbine Technology", Rolls-Royce.

Sawyer R T, "Gas turbine construction", including operation and maintenance. [J]. 2013.

《微型燃气涡轮发动机设计与制造》（自编中文教材）

廉筱纯、吴虎，《航空发动机原理》，西北工业大学出版社。

刘长福、邓明，《航空发动机结构分析》，西北工业大学出版社。

陈光，《航空发动机结构设计分析》（第二版），北京航空航天大学出版社。

闫晓军，《典型航空发动机结构对比与分析》，北京航空航天大学出版社。

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		25		
课堂表现 Class Performance		25		
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments		25		
期中考试 Mid-Term Test				
期末考试 Final Exam		15		
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)**

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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

