**上海交通大学课程教学大纲**

**SJTU Course Syllabus**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A. 课程基本信息/Course Information | | | | | | | |
| 课程代码  Course Code | AV413 | 学时  Credit Hours | 48 | 学分  Credits | | 3 | |
| 课程名称  Course Title | 发动机设计  Aircraft Engine Design | | | | | | |
| 课程性质  Course Type | 专业选修课  Professional elective | | | | | | |
| 授课对象  Intended Audience | 大四本科生  Senior undergraduate students | | | | | | |
| 授课语言  Language of  Instruction | 中文  Chinese | | | | | | |
| 开课院系  Offered by | 航空航天学院  School of Aeronautics and Astronautics | | | | | | |
| 先修课程  Prerequisite(s) | 工程热力学、空气动力学、传热学、燃气轮机原理  Engineering thermodynamics, Aerodynamics, Heat transfer, Propulsion principle | | | | | | |
| 授课教师  Instructor(s) | 马威  MA Wei | | 课程网址  Course Webpage | |  | |
| 课程简介  Course  Description | 本课程是航空航天工程专业本科生的专业先修课。航空发动机是飞机的心脏，被称为工业桂冠上的明珠，标志着一个国家的综合国力水平。航空发动机设计是一个多学科、复杂的综合性系统工程。本课程主要针对双通道干线客机使用的大涵道比涡轮风扇发动机，主要介绍发动机的气动设计和热力学设计过程。教学内容主要包括：飞机空气动力学；航空发动机推力；热力学循环；发动机类型及原理；可压缩气体的基础流体力学；增压比、单位推力、涵道比的选择；动力学标度及尺度分析；压气机和涡轮转子动力学；部件特性；非设计工况下的发动机匹配。本课程的教学目标是培养学生掌握航空发动机设计的基本原理，了解航空发动机设计工作者的思维方式及研究方法并激发出发动机设计的兴趣，同时帮助学生认识在全球化背景下的发动机行业市场环境，认识到我国在发动机制造方面面临的社会问题；培养学生的责任意识和危机意识，帮助建立学生的主动学习和终身学习意识。  This course is a professional elective for senior undergraduate students majoring in aerospace engineering. Aircraft engine is the heart of the aircraft, known as the crown jewel of industry, and a sign of the level of overall national strength of a country. Aircraft engine design is multidisciplinary, complex and comprehensive system engineering. This course is mainly about the engine aerodynamic design and thermodynamic design process of high bypass ratio turbofan engine for dual-channel large-scale airliner. The main contents include: the aerodynamics of the aircraft, the creation of thrust in a jet engine, the gas turbine cycle, the principle and layout of jet engines, the principle and layout of jet engines, the elementary fluid mechanics of compressible gases, selection of fan pressure ratio, specific thrust and bypass ratio, dynamic scaling and dimensional analysis, turbomachinery of compressors and turbines, component characteristics, engine matching off-design. The purpose of this course is to train students to master the basic principles of aircraft engine design, to understand the way of thinking of aircraft engine design workers and research methods, and to stimulate students’ interest in engine design, at the same time to help students to understand the market environment of engine industry in the context of globalization, recognize the social problems our country faces in engine manufacturing, cultivate students 'sense of responsibility and sense of crisis, and help to build students' active learning and lifelong learning awareness. | | | | | | |
| B. 课程教学大纲/Detailed Syllabus | | | | | | | |
| 1. 学习目标/Learning Outcomes  (1) Have a specific knowledge of the aerodynamic of the aircraft, the gas turbine cycle, the elementary fluid mechanics of compressible gases. *(Evaluation methods: quizzes, team presentation*) (A3.1, A5, D7, D8)  (2) Have an ability to obtain the requirements of new efficient aircraft. (*Evaluation methods: quizzes*) *(A5)*  (3) Have an ability to design a jet engine to meet these requirements. *(Evaluation methods: homework, quizzes, team presentation) (B2, B6.2, C6)*  (4) Have an ability to give a team presentation about characteristics of the existing famous aircraft engines, which are different for each team. *(Evaluation methods: team presentation*) (B1, B4)  (5) Have an ability to understand the impact of aircraft engine design in a global and societal context. *(Evaluation methods: quizzes, team presentation*) (C3, C7, C8)  (6) Have an ability to recognize the need for and an ability to engage in life-long learning about aircraft engine requirements and design. *(Evaluation methods: quizzes, team presentation*) (C4, C9)  (7) Have an ability to program the aircraft engine design process. *(Evaluation methods: team presentation) (A4)* | | | | | | | |
| 2. 教学内容、进度安排及要求/Schedule & Requirements   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 教学内容  Topic | 学时  Credit  Hour | 教学方式  Format | 作业及要求  Assignment | 基本要求  Requirement | 考查方式  Evaluation | | Course Introduction | 3 | Classroom teaching | No | Understanding | Team presentation & *Quizzes* | | The Development of Aircraft Engine | 4 | Classroom teaching | No | Understanding | Team presentation & *Quizzes* | | Introduction of Aircraft Engine Design | 2 | Classroom teaching | No | Understanding | Team presentation & *Quizzes* | | Overall performance design | 3 | Classroom teaching | Yes | Understanding | Team presentation & *Quizzes* | | Overall structure design | 3 | Classroom teaching | No | Understanding | Team presentation & *Quizzes* | | Design of Compressor, Combustor and Turbine | 6 | Classroom teaching | Yes | Understanding | Team presentation & *Quizzes* | | Aviation Engine Visit | 3 | Visit | No | Understanding | Team presentation & *Quizzes* | | CFM56 Engines | 2 | Classroom teaching | No | Understanding | Team presentation & *Quizzes* | | Quizzer | 1 | Quizzer | No | Quizzer | - | | Overall performance design - Program | 9 | Programming | Yes | Programming | Team presentation | | Design of Compressor - Program | 9 | Programming | Yes | Programming | Team presentation | | New concepts of Aircraft Engines | 3 | Classroom teaching | No | Understanding | - | | | | | | | | |
| 3. 考核方式及规定/Grade Composition and Grading Policy  Usual Performance 20%  Quizzes 20%  Homework & Team Presentation 60%  Total 100% | | | | | | | |
| 4. 教材或参考资料Textbook & References   1. Aircraft Propulsion, Saeed Farokhi, 2014 2. Gas Turbine Theory, Sixth edition, HIH Saravanamuttoo, GFC Rogers, H Cohen and PV Staznicky.2009 3. Jet Propulsion: A Simple Guide to the Aerodynamics and Thermodynamic Design and Performance of Jet Engines. Third Edition. Nicholas Cumpsty, Andraw Heyes. 2015. 4. 《航空发动机设计手册 第5册 涡喷及涡扇发动机总体》，航空工业出版社，2001. 5. 《推进原理与设计》，滕金芳 等，上海交通大学出版社，2015. 6. 《发动机设计-上海交通大学航空航天专业讲义》，滕金芳，2013. | | | | | | | |
| 5. 其它/Additional Information: | | | | | | | |
| 6. 备注/Note(s): | | | | | | | |

A 价值引领

A1 坚定理想信念，践行社会主义核心价值观

A2 厚植家国情怀，担当民族伟大复兴重任

A3 立足行业领域，矢志成为国家栋梁

A3.1 树立“奋发图强、空天报国”信念

A4 追求真理，树立创造未来的远大目标

A5 胸怀天下，以增进全人类福祉为己任。

B 知识探究

B1 深厚的基础理论

B2 扎实的专业核心

B3 宽广的跨学科知识

B4 领先的专业前沿

B5 广博的通识教育

B6.1 掌握本专业所需的数学、物理、电子、信息等基本理论知识和技能；

B6.1.1 了解并理解专业学习所必需的数学、物理、电子及信息等相关知识；

B6.1.2 掌握基础物理实验操作、电子及信息应用等基本技能；

B6.1.3 掌握科学实验（研究）的基本的方法论。

B6.2 掌握完整的航空航天工程的基础知识体系，理解科学、工程、社会的关系，理解航空航天系统的复杂性，正确认识航空航天作为现代社会最尖端的技术之一的重要性和潜在的发展能力；

B6.2.1 掌握航空航天的知识体系，包括航空航天概论、飞行力学、自动控制原理、飞行器控制、 空气动力学、固体力学与结构、飞行器结构力学、工程热力学、推进原理、飞行器设计、发动机设计、航空安全与人为因素等内容；

B6.2.2 掌握必要的控制、风洞、结构强度、叶轮机械等实验技能以及相关的实验数据处理和分析方法；

B6.2.3 掌握一般工程设计、飞行器设计、发动机设计等设计方法，在具体的飞行器设计尝试中体会系统的复杂性以及如何协调各种设计指标。

C能力建设

C1 审美与鉴赏能力

C2 沟通协作与管理领导能力

C3 批判性思维、实践与创新能力

C4 跨文化沟通交流与全球胜任力

C5 终身学习和自主学习能力

C6 熟练运用各种现代媒体技术获取科学研究信息，包括英文信息的能力；

C7 系统地掌握本专业的基本实验方法与技能，能够归纳、整理、分析实验结果

C8 初步具备协调各种设计指标、进行飞行器系统设计的能力

C9 具备较强的口头与书面表达能力，撰写学术论文和参与学术交流

D人格养成

D1 刻苦务实、意志坚强

D2 努力拼搏，敢为人先

D3 诚实守信，忠于职守

D4 身心和谐、体魄强健

D5 崇礼明德，仁爱宽容

D6 通过学习职业道德和学术诚信标准并实践，初步养成良好的职业诚信素质

D7 具备关于大型工程系统的复杂性的认识

D8 具备关于社会因素和社会影响力在本专业中的重要性的认识

D9 初步具备科学素养