

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	精密加工技术 Precision Machining Technology
2.	授课院系 Originating Department	机械与能源工程系 Department of Mechanical and Energy Engineering
3.	课程编号 Course Code	ME407
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业核心课 Major Core Course
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	中英双语 English & Chinese
8.	授课教师、所属学系、联系方式 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	徐少林/助理教授/机械与能源工程系 Shaolin Xu / Assistant professor / Department of Mechanical and Energy Engineering Email: xusl@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	习题/辅导/讨论	实验/实习	其它(请具体注明)	总学时
	Lectures	Tutorials	Lab/Practical	Other (Please specify)	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					
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
14. 其它要求修读本课程的学系 Cross-listing Dept.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

<p>精密加工技术是制造领域的关键核心技术，是机械制造类学生的专业核心课程。</p> <p>Precision machining technology is the key technology in the modern manufacturing industry as well as a major core course for mechanical manufacturing students.</p> <p>该课程的教学目标在于通过课堂教学和实际动手实验，让学生熟练深入掌握精密加工技术的基础原理、工业应用及其前沿发展趋势。首先讲授超精密机械加工技术及超精密机床技术，包含其加工原理、加工工艺、机床构造及设计原则、测量及加工质量评价等；其次重点讲解前沿的复合加工技术，包含其加工原理、设备构成及原理和工业应用；最后专题讲解采用各种新型超精密加工技术进行微纳制造的研究及应用现状。</p> <p>The purpose of this course is to provide students with a comprehensive and deep understanding of the fundamentals, industrial applications and cutting-edge development of precision machining technology by lectures and lab experiments. Initially, ultraprecision mechanical machining technologies and ultraprecision machine tools will be discussed, including machining mechanism, techniques, machine tools construction and design principles, measurement and quality evaluation etc.; then, the nonconventional hybrid machining techniques will be discussed, including their mechanism, equipment construction and industrial application; finally, the current research and application on micro/nano-fabrication with various types of new ultraprecision machining techniques will be discussed in terms of special subjects.</p>

16. 预达学习成果 Learning Outcomes

<p>该课程拟通过精密加工原理、加工过程中的科学问题、设备构成、设计原则及其工业应用的讲解，结合各加工技术的前沿研究成果，让学生对精密加工技术的发展趋势有系统的了解。并在自我实践的环节结合实验设计和动手实验，提升对精密加工技术的理论和实践的认知程度，为未来从事该领域的理论和应用研究，培养兴趣，并打下坚实的基础。</p> <p>The course tends to provide students with a systematic understanding of the development trend of ultraprecision machining technology through the discussion of precision machining mechanisms, related scientific problems, equipment construction, design principles and industrial applications, combined with the current research status of various precision machining techniques. It aims to help students deeply understand the theory and practice of precision machining technologies through the learning experience and provide necessary knowledge for their theoretical and applied research in this field for the future.</p>

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	Lectures: Introduction to ultraprecision machining and machine tool technologies (精密加工技术简介) Lab/Practical: Introduction to experiment projects (实验课题介绍)
Section 2	Lectures: Cutting: fundamentals, single-point diamond cutting, ductile-mode cutting, etc. (切削: 基础, 单点金刚石切削, 延性域切削等) Lab/Practical: Demonstration of ultraprecision cutting and grinding (超精密切削及磨削实验演示)
Section 3	Lectures: Tribology in ultraprecision cutting (超精密切削中的摩擦学) Lab/Practical: Literature review and experiment design (文献综述及实验设计)
Section 4	Lectures: Typical scientific problems in ultraprecision cutting (超精密切削中的典型科学问题) Lab/Practical: Nano precision cutting of spherical and aspherical optical molds (球面及非球面光学模具的纳米精度超精密切削实验)
Section 5	Lectures: Grinding: fundamentals, wear mechanisms and conditioning of grinding wheels (磨削基础, 砂轮磨损及修型修整技术) Lab/Practical: Literature review and experiment design (文献综述及实验设计)
Section 6	Lectures: Mirror surface grinding, aspherical grinding, glass optic manufacturing, etc. (镜面精磨, 非球面精磨, 光学玻璃镜片加工技术等) Lab/Practical: Nano precision grinding of spherical and aspherical optical molds (球面及非球面光学模具的纳米精度超精密磨削实验)
Section 7	Lectures: Lapping and polishing: fundamentals, chemical mechanical polishing, etc. (研磨与抛光: 基础, 化学机械研磨等) Lab/Practical: Nano scratching of typical brittle materials (典型硬脆性材料的纳米划痕实验)
Section 8	Mid-Term Test (Short oral presentation and discussion in selected topics) 期中考试 (就选定课题进行口头演讲和讨论)
Section 9	Lectures: Ultraprecision basic components (超精密基础元部件) Lab/Practical: Literature review and experiment design (文献综述及实验设计)
Section 10	Lectures: Measurement and error compensation in ultraprecision machining (精密加工技术中的测量以及误差补偿技术) Lab/Practical: Set up a laser interferometer and related displacement measurement (精密激光干涉测量系统的搭建及测距应用)
Section 11	Lectures: Construction and design principles of precision machine tools (超精密加工机床的构造及设计原则) Lab/Practical: Literature review and experiment design (文献综述及实验设计)
Section 12	Lectures: Introduction to hybrid machining technologies (复合加工技术介绍) Lab/Practical: Thermal and UV nanoimprinting lithography for periodic structures fabrication (热/紫外纳米压印制备周期性微纳结构)
Section 13	Lectures: Ultrasonic assisted machining: fundamentals and applications (超声辅助加工: 基础及应用) Lab/Practical: Literature review and experiment design (文献综述及实验设计)
Section 14	Lectures: Laser assisted machining: fundamentals and applications (激光辅助加工: 基础及应用) Lab/Practical: Femtosecond laser micromachining of metal and semiconductor materials (飞秒激光用于金属及半导体材料的微纳加工)
Section 15	Lectures: Micro/nano-fabrication technologies and their applications (微纳制造技术及其应用) Lab/Practical: Fabrication of nanoscale 3D components with femtosecond laser TPP/MPP processes (基于飞秒激光双光子及多光子聚合的微纳 3D 构件制备)

Section 16	Final Exam (Oral presentation and discussion in selected projects) 期末考试 (就选定课题进行口头演讲和讨论)
------------	---

Note: 2+2 hours/section;

Laboratories 实验部分

Pre-Laboratory: Introduction and safety training
实验课程安排介绍及安全培训

Lab 1: Nano precision cutting of spherical and aspherical optical molds
实验 1: 球面及非球面光学模具的纳米精度超精密切削实验

Lab 2: Nano precision grinding of spherical and aspherical optical molds
实验 2: 球面及非球面光学模具的纳米精度超精密磨削实验

Lab 3: Nano scratching of typical brittle materials
实验 3: 典型硬脆性材料的纳米划痕实验

Lab 4: Set up a laser interferometer and related displacement measurement
实验 4: 精密激光干涉测量系统的搭建及测距应用

Lab 5: Thermal and UV nanoimprinting lithography for periodic structures fabrication
实验 5: 热/紫外纳米压印制备周期性微纳结构

Lab 6: Femtosecond laser micromachining of metal and semiconductor materials
实验 6: 飞秒激光用于金属及半导体材料的微纳加工

Lab 7: Fabrication of nanoscale 3D components with femtosecond laser TPP/MPP processes
实验 7: 基于飞秒激光双光子及多光子聚合的微纳 3D 构件制备

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

<p>教材 Textbook:</p> <p>(1) 精密超精密加工技术新进展, 杨辉, 航空工业出版社, 2016</p> <p>(2) Fundamentals of machining and machine tools, 3rd ed, Geoffrey Boothroyd, Winston A. Knight, Boca Raton, Fla. : CRC Press/Taylor & Francis, 2005.</p> <p>参考教材 Supplementary Readings:</p> <p>(3) 精密和超精密加工技术(第 3 版), 袁哲俊, 王先逵, 机械工业出版社, 2016.</p>

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		10		
课堂表现 Class Performance		20		
小测验 Quiz				
课程项目 Projects		40		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation		30		

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

机械与能源工程系教学委员会

