

ME303 《机械设计基础》 课程大纲

- 1、2019 春季学期-2022 春季学期 (2)
- 2、2022 秋季学期起 (10)

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	机械设计基础 Fundamentals of Mechanical Design
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	ME303
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业核心课 Major Core Courses
6.	授课学期 Semester	春季 Spring/秋季 Fall
7.	授课语言 Teaching Language	英文 English / 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) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	秋季 (Fall): 宋超阳, 机械与能源工程系, songcy@sustech.edu.cn Department of Mechanical and Energy Engineering Song Chaoyang, songcy@sustech.edu.cn 春季 (Spring): 王宏强, 机械与能源工程系, wanghq6@sustc.edu.cn Department of Mechanical and Energy Engineering Wang Hongqiang, wanghq6@sustech.edu.cn

9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	肖啸川, 机械与能源工程系, xiaoxc@sustech.edu.cn Department of Mechanical and Energy Engineering Xiao Xiaochuan, xiaoxc@sustech.edu.cn				
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	ME102 CAD 与工程制图 CAD and Engineering Drawing MAE203 理论力学 I -B Engineering Mechanics I – Statics and Dynamics MSE305 或者 MAE202 材料力学 Mechanics of Materials				
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	创新设计实践 Innovative Design Practice 产品设计实践 Product Design Practice				
14.	其它要求修读本课程的学系 Cross-listing Dept.	Not Applicable				

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

This course is intended for students beginning the professional study of mechanical engineering. The focus is on combining fundamental concept development with practical specification of mechanical components. Subjects covered by this course include engineering basics, failure prevention, gear components, joint components, flexible components and various other mechanical components. Special topics will be covered regarding the pathway from mechanical engineering fundamentals towards future directions of design engineer in research and industry towards advanced machinery, automation and robotics.

- To teach students how to formulate the design and manufacturing problem for mechanical systems.
- To teach students how to apply the general mechanical engineering sciences in analyses specific to the design of

mechanical components.

- To teach students in a laboratory setting how to generate concepts, conduct analyses to size components, construct, assemble, and program a prototype of a system and test its function to meet the specifications of a design and manufacturing problem.
- To reinforce students' team skills through a team project, including problem formulation, problem solutions and written reporting of results.
- To reinforce students' visualization and hands--on skills through project virtual prototyping and/or physical construction exercises.

16. 预达学习成果 Learning Outcomes

As a core course for mechanical engineering major, this course lays the foundation for students to conduct machine design, manufacturing and related research and development. The following learning outcomes are expected for students taking this course:

1. Given functional and manufacturing requirements, utilize concept generation methods within a team setting to achieve a consensus for a product concept.
2. Weigh trade-offs in concept and detail design from the perspectives of function, manufacture, design effort and available resources.
3. Apply basics of conservation and constitutive laws from the mechanical engineering sciences to understand the basic nature of a posed problem.
4. Compile reference (e.g. catalogue, handbook and textbook) resources to formulate an analysis for specific mechanical and mechatronic components addressed within those resources.
5. Make decisions regarding buy or build for individual components of a design.
6. Test, in a team setting or independently, the system performance and all failure modes that may be present per the analyses conducted during the design stage.
7. Communicate engineering decisions, justification for those decisions, designs, manufacturing plans, and test results in multi-media presentation and report writing.

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.)

课程内容	教学要求	学时 分配

<p>Introduction to Mechanical Design</p> <ul style="list-style-type: none"> • Basics about mechanical design • Fundamental notions and approaches to design. 	<p>Understand process of mechanical design.</p> <p>Understand analysis tools.</p>	2
<p>Materials</p> <ul style="list-style-type: none"> • Material properties • Basic treatment methods • Metals and non-metals 	<p>Learn to material types and mechanical properties</p> <p>Understand basic material treatment method</p>	2
<p>Kinematics & Load Analysis</p> <ul style="list-style-type: none"> • Mechanism basics • Linkage motions • Equilibrium and free-body diagrams • Load analysis 	<p>Understand kinematics and degree of freedom</p> <p>Learn complex linkage motion analysis method</p> <p>Learn load analysis method of mechanical structure</p>	4
<p>Failures Resulting from Static Loading</p> <ul style="list-style-type: none"> • Relations between strength and static loading • Failure theories for ductile materials • Failure Theories for Brittle Materials 	<p>Understand the importance of failure analysis.</p> <p>Understand the failure theories for ductile materials.</p> <p>Understand the failure theories for brittle materials.</p> <p>Learn the selection method of failure criteria</p>	2
<p>Fatigue Failures Resulting from Variable Loading</p> <ul style="list-style-type: none"> • Introduction to fatigue in metals • Fatigue-life methods • Fatigue strength & the endurance limit • Stress concentration and notch sensitivity 	<p>Understand the fatigue failure stages in metals</p> <p>Learn the fatigue life methods</p> <p>Understand Fatigue strength & the endurance limit</p> <p>Understand the Stress Concentration and Notch Sensitivity</p>	2
<p>Gears in General</p> <ul style="list-style-type: none"> • Key concepts about gears • Common Gears • Force Analysis 	<p>Understand about key concepts of gears.</p> <p>Learn the types of common gears.</p> <p>Learn the force analysis of gears.</p>	2
<p>Spur, Helical, Bevel & Worm Gears</p> <ul style="list-style-type: none"> • The basic concepts and analysis theories about 	<p>Understand the analysis and design methods for gears spur & helical gears</p>	2

<p>spur & helical gears</p> <ul style="list-style-type: none"> • The basic concepts and analysis theories about bevel & worm gears 	<p>Understand the analysis and design methods for gears bevel & worm gears.</p>	
<p>Shafts and Shaft components</p> <ul style="list-style-type: none"> • Shaft Materials • Shaft Layout • Example of Shaft Design • Shaft Components • Limits and Fits 	<p>Understand shaft geometric structures and functions</p> <p>Learn the process to design a shaft</p>	2
<p>Power Transmission Case Study</p> <ul style="list-style-type: none"> • A power transmission system design 	<p>Learn how to incorporate the details of each component into an overall design process</p>	2
<p>Non-permanent Joints (Screws, Fasteners)</p> <ul style="list-style-type: none"> • The Mechanics of Power Screws • Joints—Fastener/Member Stiffness • Tension Joints—The External Load 	<p>Understand pre-tightening and anti-loosening of threaded connections</p> <p>Learn the theories about joints—fastener/member stiffness, and tension joints—the external load</p>	2
<p>Permanent Joints (Welding, Bonding)</p> <ul style="list-style-type: none"> • Butt and Fillet Welds • Stresses in Welded Joints in Torsion Bending • The Strength of Welded Joints 	<p>Understand advantages and applications of welding and bonding.</p> <p>Learn the typical welding and bonding methods.</p> <p>Understanding the stresses in welded joints in torsion or bending, and the strength of welded joints</p>	2
<p>Bearings, Lubrication, Brakes & Couplings</p> <ul style="list-style-type: none"> • Rolling-contact bearing types • The purposes of an antifriction-bearing lubrication • Static analysis of clutches and brakes 	<p>Know about rolling-contact bearing types.</p> <p>Understand the purposes of an antifriction-bearing lubrication</p> <p>Understand the static analysis, types, and materials of clutches and brakes</p>	2
<p>Mechanical Springs</p> <ul style="list-style-type: none"> • Types of springs • Design of spring 	<p>Understand types of springs</p> <p>Learn the basic theories of design springs</p>	2

<p>Flexible Mechanical Components</p> <ul style="list-style-type: none"> • Different types of flexible mechanical components • The characteristics of flexible mechanical structures 	<p>Understand differences between flexible and rigid mechanical components.</p> <p>Learn the characteristics of different types of flexible mechanical components such as belts, flat- and round-belt drives, v belts, timing belts, roller chain, wire rope, flexible shafts.</p>	2
<p>Mechanical Design for Advanced Robotics</p> <ul style="list-style-type: none"> • Robot Design Process • Mechanical Design Considerations 	<p>Know about advanced robotics.</p> <p>Understand design process of robotics.</p>	2
Lab		
<p>Training and task</p> <ul style="list-style-type: none"> • Lab machine training 	Learn to operate machines in this lab	2
<p>Four-bar linkages</p> <ul style="list-style-type: none"> • Four-bar linkage • Mechanism principle 	<p>Build linkage and cam structures</p> <p>Understand the DoFs of a mechanical mechanism</p>	6
<p>Project I: design and fabrication</p> <ul style="list-style-type: none"> • Machines operating • Mechanical design based on simple mechanisms and components 	<p>Design and fabricate a prototype using linkages.</p> <p>Learn to write mechanical design report.</p>	2
<p>Project II: Manual Targeting Machine</p> <ul style="list-style-type: none"> • Design of complex mechanisms 	<p>Design and fabricate a machine with higher precision.</p> <p>Enhance leadership and cooperation skills</p>	10
<p>Presentation & Competition</p> <ul style="list-style-type: none"> • Engineering expression skills 	<p>Hone the presentation skills of engineering product.</p> <p>Learn to evaluate and judge different engineering approaches</p>	2
<ul style="list-style-type: none"> • Project III: Shaft design 	Learn to design and evaluate shafts in a gear box	10

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

<ul style="list-style-type: none"> • Textbook: Shigley's Mechanical Engineering Design (McGraw-Hill Series in Mechanical Engineering) 10th Edition by Richard G Budynas (Author), Keith J Nisbett (Author)
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- **Supplementary Readings:** Machine Design (5th Edition) 5th Edition by Robert L. Norton (Author)

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		20%		
课堂表现 Class Performance		0		
小测验 Quiz		0		
课程项目 Projects		30%		
平时作业 Assignments		20%		
期中考试 Mid-Term Test		0		
期末考试 Final Exam		30%		
期末报告 Final Presentation		0		
其它（可根据需要 改写以上评估方式） Others (The above may be modified as necessary)		0		

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

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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。

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1. 课程名称 Course Title	机械设计基础 Fundamentals of Machine Design
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	ME303
4. 课程学分 Credit Value	3
5. 课程类别 Course Type	专业核心课 Major Core Courses
6. 授课学期 Semester	秋季 Fall / 春季 Spring
7. 授课语言 Teaching Language	中英双语 English & Chinese / 中文 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) Instructor(s), Affiliation & Contact (For team teaching, please list	责任教师/Principal Instructor: 宋超阳 / Song Chaoyang 秋季 / Fall: 宋超阳 / Song Chaoyang 机械与能源工程系/MEE songcy@sustech.edu.cn 春季 / Spring: 邓辉 / Deng Hui 机械与能源工程系/MEE

all instructors)		dengh@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	ME102 CAD 与工程制图 CAD and Engineering Drawing MAE203 理论力学 I -B Engineering Mechanics I – Statics and Dynamics MSE305 或者 MAE202 材料力学 Mechanics of Materials				
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

机械设计是一门培养学生具有机械设计能力的专业技术基础课，是机械类专业培养方案中的主干课程。本课程在教学内容方面应着重传授基本知识、基本理论和基本方法，在培养实践能力方面应着重创新设计构思和综合设计技能的基本训练。

本课程的主要任务是通过课程教学培养学生：机械工程科学知识的应用能力；设计机械系统、部件和零件的能力；对于机械工程问题进行系统表达、建立模型、分析求解和论证的能力；在机械工程实践中初步掌握并使用各种技术、技能和现代化设计工具的能力。

Mechanical design is a professional technical foundation course to cultivate students with mechanical design ability, is the main course in the training program of mechanical majors. This course should focus on teaching the basic knowledge,

basic theory and basic methods, and in the cultivation of practical ability should focus on the basic training of innovative design ideas and comprehensive design skills.

The main task of this course is to cultivate students through the course teaching: the application of mechanical engineering scientific knowledge; the ability to design mechanical systems, components and parts; for mechanical engineering problems for the systematic expression, modeling, analysis and demonstration of the ability to solve; in the mechanical engineering practice and the initial mastery of various technologies, skills and modern design tools.

16. 预达学习成果 Learning Outcomes

本课程主要面向机械工程、机器人工程及力学与航空航天专业本科生开设，预达学习成果如下：

1. 能够通过应用工程、科学和数学原理识别、制定和解决复杂的工程问题
2. 能够应用工程设计来产生满足特定需求的解决方案，并考虑到公共健康、安全和福利，以及全球、文化、社会、环境和经济因素。
3. 具有与各种受众有效沟通的能力
4. 能够认识到工程情况下的道德和专业责任，并作出明智的判断，必须考虑工程解决方案在全球、经济、环境和社会背景下的影响。
5. 有能力在一个团队中有效运作，其成员共同提供领导，创造一个合作和包容的环境，建立目标，计划任务，并达到目标
6. 有能力开发和进行适当的实验，分析和解释数据，并使用工程判断来得出结论
7. 有能力使用适当的学习策略，根据需要获取和应用新知识
8. 有能力将现代计算机工程工具的使用融入工程实践中

This course is intended for undergraduate students in mechanical engineering, robotics engineering, and mechanics and aerospace, with the following learning outcomes.

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed

judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. an ability to integrate the use of modern computer-based engineering tools into engineering practice

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.)

每周两次授课，每次授课 2 小时，其中单周均为基础理论课，双周一节为基础理论课、一节为习题项目课。

-基础理论课：围绕核心机械零件，结合教材内容展开教学，分为八个章节

-习题项目课：结合课堂内容进行习题讲解，或结合实践项目进行分组指导

-实践项目：

○ 专业工业软件操作认证：AutoDesk Fusion 360 基础、仿真 在线认证

○ 机械零件设计主题报告：结合年度主题，针对具体零件或机械系统，分组撰写机械设计报告

第 01 周：第 01 章 – 机械设计总论（上）、（中）

第 02 周：第 01 章 – 机械设计总论（下）、习题项目课

第 03 周：第 02 章 – 平面连杆机构（上）、（中）

第 04 周：第 02 章 – 平面连杆机构（下）、习题项目课

第 05 周：第 03 章 – 齿轮传动设计（上）、（中）

第 06 周：第 03 章 – 齿轮传动设计（下）、习题项目课

第 07 周：第 04 章 – 轴承及轴设计（上）、（中）

第 08 周：第 04 章 – 轴承及轴设计（下）、习题项目课

第 09 周：第 05 章 – 连接及连接件（上）、（中）

第 10 周：第 05 章 – 连接及连接件（下）、习题项目课

第 11 周：第 06 章 – 挠性传动设计（上）、（中）

第 12 周：第 06 章 – 挠性传动设计（下）、习题项目课

第 13 周：第 07 章 – 支承零件设计（上）、（中）

第 14 周：第 07 章 – 支承零件设计（下）、习题项目课

第 15 周：第 08 章 – 其他机械设计（上）、（中）

第 16 周：第 08 章 – 其他机械设计（下）、报告项目课

The lectures are held twice a week for 2 hours each time, in which one week is devoted to basic theory class, and the other week is devoted to basic theory class and one exercise project class.

-Basic theory class: the core mechanical parts, combined with the content of the textbook to start teaching, divided into eight chapters

-Exercise project class: the classroom content is combined with exercise lectures, or combined with practical projects for group instruction

-Practical projects

- Professional industrial software operation certification: AutoDesk Fusion 360 basic, simulation online certification
- Mechanical component design topic reports: group writing of mechanical design reports for specific components or mechanical systems in conjunction with annual topics

Week 01: Chapter 01 - General Introduction to Mechanical Design (1), (2)

Week 02: Chapter 01 - General Introduction of Mechanical Design (3), Exercise Project Session

Week 03: Chapter 02 - Planar Linkage Mechanism (1), (2)

Week 04: Chapter 02 - Plane Linkage Mechanism (3), Exercise Project Session

Week 05: Chapter 03 - Gearing Design (1), (2)

Week 06: Chapter 03 - Gearing Design (3), Exercise Project Session

Week 07: Chapter 04 - Bearing and Shaft Design (1), (2)

Week 08: Chapter 04 - Bearing and Shaft Design (3), Exercise Project Session

Week 09: Chapter 05 - Connections and Connectors (1), (2)

Week 10: Chapter 05 - Connections and Connectors (3), Exercise Project Session

Week 11: Chapter 06 - Flexible Components (1), (2)

Week 12: Chapter 06 - Flexible Components (3), Exercise Project Session

Week 13: Chapter 07 - Design of Supporting Components (1), (2)

Week 14: Chapter 07 - Design of Supporting Components (3), Exercise Project Session

Week 15: Chapter 08 – Other Topics in Machine Design (1), (2)

Week 16: Chapter 08 – Other Topics in Machine Design (3), Report Project Session

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

- 华中科技大学，机械设计（第三版），Textbook by HUST on Mechanical Design
- 华中科技大学，机械原理（第二版），Textbook by HUST on Mechanism Design
- 高等教育出版社，机械设计基础（第六版），Textbook by Zhu Kezhen on Mechanical Design

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				
小测验 Quiz				
课程项目 Projects		20%		

平时作业 Assignments		20%		
期中考试 Mid-Term Test				
期末考试 Final Exam		30%		
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**

<input checked="" type="checkbox"/> A. 十三级等级制 Letter Grading <input type="checkbox"/> 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

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