

ME333 《机电一体化系统》课程大纲

- 1、2023 春季学期——2024 春学期 (2)
- 2、2024 秋学期起 (9)

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	机电一体化系统 Mechatronic Systems
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	ME333
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 (2023 春季学期—2024 春学期)
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 (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)	柯文德, 机械与能源工程系 Wende Ke, Department of Mechanical and Energy Engineering, kewd@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	30	2	32		64
12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	机器人建模与控制 (ME331) Robot Modeling and Control				
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

机电一体化是随着生产和技术的发展,从系统观点出发,将机械技术、微电子技术、计算机信息技术、自动控制技术等,在系统工程的基础上有机加以综合,实现整个机械系统最优化而建立起来的一门新的科学技术,其主要特征为系统的整体结构最优化、控制智能化、操作性能柔性化等方面。按照机电一体化思想,凡是由各种现代高新技术与机械和电子技术相互结合而形成的各种技术、产品以及系统都属于机电一体化范畴。

通过为我校机械工程专业与机器人工程专业本科生该课程知识,有助于培养具有创新探索精神、高素质的复合型机电工程类人才,使其掌握机电系统基本原理、设计理论及方法,并为后续的专业课程打下坚实的理论和实践基础。

Mechatronics is a new kind of science established with the development of production and technology. From the system perspective, it is organically integrated with mechanical technology, microelectronics, computer information, automatic control, etc., to achieve the optimization of the entire mechanical system.

based on system engineering. Its main characteristics are the optimization of overall system structure, intelligent control, flexible operating performance, etc. According to the idea of mechatronics, all kinds of technologies, products and systems formed by the combination of various modern high-tech and mechanical and electronic technologies belong to the category of mechatronics.

This course are for the undergraduate students of mechanical engineering and robot engineering in our university. It is helpful to cultivate high-quality composite electronic and mechanical engineering talents with the spirit of innovation and exploration, make them master the basic principles, design theories and methods of electronic and mechanical systems, and help them to lay a solid theoretical and practical foundation for the subsequent professional courses.

16. 预达学习成果 Learning Outcomes

《机电一体化系统》课程通过系统性讲授机电一体化系统的基本原理及方法，涵盖机械系统设计、检测系统设计、控制系统设计、机电一体化计算机接口设计、伺服系统设计等知识，并在此基础上阐述及分析典型机电一体化系统设计案例。授课过程中，还将采用课程分组项目实现学生对本课程知识的学习目标，提高学生实际能力、培养学生国际化思维以及团队协作管理复合能力的目标，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。

This course systematically illustrates the basic principles and methods of mechatronic systems, covering mechanical system, detection system, control system, mechatronic computer interface, servo system and other relevant knowledge. Then it will describe and analyze typical mechatronic system design cases in detail. While in teaching process, we will also adopt course grouping projects to help students to achieve the learning objectives, improve their practical ability, cultivate the international thinking and team cooperation management ability. Furthermore, we believe that this course will also help them to lay a solid foundation for future theoretical and applied research in mechatronic.

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.)

Week	内容
1 (2 课时) 1 (2 credit hours)	机电一体化概述及系统设计方法 Overview of mechatronics and system design methods
2 (2 课时) 2 (2 credit hours)	机械系统的结构设计及主要动力学参数 Structural design and main dynamic parameters of mechanical system
3 (2 课时) 3 (2 credit hours)	机械系统部件的选择计算 Selection and calculation of mechanical system components
4 (2 课时) 4 (2 credit hours)	机械系统执行电动机的选择计算、动力学特性分析 Selection calculation and dynamic characteristics analysis of executive motor in

	mechanical system
5 (2 课时) 5 (2 credit hours)	机电一体化系统常用传感器、信号放大电路 Sensors and signal amplification circuits commonly used in mechatronics systems
6 (2 课时) 6 (2 credit hours)	信号放大电路、信号调制与解调电路 Signal amplification circuit, signal modulation and demodulation circuit
7 (2 课时) 7 (2 credit hours)	信号的滤波电路、数字式传感器信号检测电路 Signal filtering circuit, digital sensor signal detection circuit
8 (2 课时) 8 (2 credit hours)	控制系统的数学模型及性能分析 Mathematical model and performance analysis of control system
9 (2 课时) 9 (2 credit hours)	控制系统的综合、校正与分析 Synthesis, Correction and Analysis of Control System
10 (2 课时) 10 (2 credit hours)	人机接口设计 User - machine interface design
11 (2 课时) 11 (2 credit hours)	过程输入通道接口设计 Interface design of process input channel
12 (2 课时) 12 (2 credit hours)	伺服系统的基本结构、要求及设计方法 Basic structure, requirements and design method of servo system
13 (2 课时) 13 (2 credit hours)	步进伺服系统设计 Design of step servo system
14 (2 课时) 14 (2 credit hours)	直流及交流伺服系统设计 Design of DC and AC Servo System
15 (2 课时) 15 (2 credit hours)	典型机电一体化系统设计与分析 Design and analysis of typical mechatronics system
16 (2 课时) 16 (2 credit hours)	习题讲解与复习 Exercise explanation and course review
实验 Experiments	
1. MDK5 开发环境安装与配置 (第 1 周, 2 节课) 1. MDK5 development environment installation and configuration (week 1, 2 credit hours)	
2. 跑马灯、按键输入实验 (第 2 周, 2 节课) 2. Marquee lamp and key input experiment (week 2, 2 credit hours)	
3. 串口通信、外部中断实验 (第 3 周, 2 节课) 3. Serial communication and external interrupt experiment (week 3, 2 credit hours)	

4. 独立看门狗、窗口看门狗实验 (第 4 周, 2 节课)
4. Independent watchdog and window watchdog experiments (week 4, 2 credit hours)
5. 定时器中断实验 (第 5 周, 2 节课)
5. Timer interrupt experiment (week 5, 2 credit hours)
6. PWM 输出实验 (第 6 周, 2 节课)
6. PWM output experiment (week 6, 2 credit hours)
7. RTC 实时时钟实验 (第 7 周, 2 节课)
7. RTC real time clock experiment (week 7, 2 credit hours)
8. ADC 实验 (第 8 周, 2 节课)
8. ADC experiment (week 8, 2 credit hours)
9. DAC 实验 (第 9 周, 2 节课)
9. DAC experiment (week 9, 2 credit hours)
10. CAN 通信实验 (第 10 周, 2 节课)
10. CAN communication experiment (week 10, 2 credit hours)
11. 传感器信号处理实验 (第 11 周, 2 节课)
11. Sensor signal processing experiment (week 11, 2 credit hours)
12. 直流减速电机控制实验 (第 12 周, 2 节课)
12. Control experiment of DC decelerator motor (week 12, 2 credit hours)
13. 步进电机控制实验 (第 13 周, 2 节课)
13. Step motor control experiment (week 13, 2 credit hours)
14. 伺服电机控制实验 (第 14 周, 2 节课)
14. Servo motor control experiment (week 14, 2 credit hours)
15. 机电一体化综合实验 (第 15、16 周, 4 节课)
15. Comprehensive Experiment of mechatronics (week 15 & 16, 4 credit hours)

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

教材: 机电一体化系统设计 (第二版). 曾励, 竺志大. 高等教育出版社, 2020

参考书:

- 1、机电一体化系统设计 (第三版). 冯浩, 汪建新, 赵书尚, 杨威. 华中科技大学出版社, 2021
- 2、机电一体化技术与系统 (第二版). 梁景凯, 刘会英. 机械工业出版社, 2022
- 3、机电一体化原理及应用 (第三版). 吕强, 孙锐, 李学生. 国防工业出版社, 2010

Textbook: Mechatronics System Design (Second Edition) Zeng Li, Zhu Zhida Higher Education Press, 2020

References:

1. Mechatronics System Design (Third Edition), Feng Hao, Wang Jianxin, Zhao Shushang, Yang Wei
Huazhong University of Science and Technology Press, 2021

2. Mechatronics Technology and Systems (Second Edition), Liang Jingkai, Liu Huiying, China Machine
Press, 2022

3. Principles and Applications of Mechatronics (Third Edition), Lv Qiang, Sun Rui, Student Li, National
Defense Industry Press, 2010

课程评估 **ASSESSMENT**

19. 评估形式 Type Assessment	评估时间 of 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				
实验 Experiments		40		
课程项目 Projects				
平时作业 Assignments		10		
期中考试 Mid-Term Test				
期末考试 Final Exam		50		
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

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课程详述

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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 (2024 秋开始)
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 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list	柯文德, 机械与能源工程系 Wende Ke, Department of Mechanical and Energy Engineering, kewd@sustech.edu.cn

all instructors)						
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	30	2	32		64
12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	机器人建模与控制 (ME331) Robot Modeling and Control				
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教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

机电一体化是随着生产和技术的发展,从系统观点出发,将机械技术、微电子技术、计算机信息技术、自动控制技术等,在系统工程的基础上有机加以综合,实现整个机械系统最优化而建立起来的一门新的科学技术,其主要特征为系统的整体结构最优化、控制智能化、操作性能柔性化等方面。按照机电一体化思想,凡是由各种现代高新技术与机械和电子技术相互结合而形成的各种技术、产品以及系统都属于机电一体化范畴。

通过为我校机械工程专业与机器人工程专业本科生该课程知识,有助于培养具有创新探索精神、高素质的复合型机电工程类人才,使其掌握机电系统基本原理、设计理论及方法,并为后续的专业课程打下坚实的理论和实践基础。

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16. 预达学习成果 Learning Outcomes

《机电一体化系统》课程通过系统性讲授机电一体化系统的基本原理及方法，涵盖机械系统设计、检测系统设计、控制系统设计、机电一体化计算机接口设计、伺服系统设计等知识，并在此基础上阐述及分析典型机电一体化系统设计案例。授课过程中，还将采用课程分组项目实现学生对本课程知识的学习目标，提高学生实际能力、培养学生国际化思维以及团队协作管理复合能力的目标，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。

This course systematically illustrates the basic principles and methods of mechatronic systems, covering mechanical system, detection system, control system, mechatronic computer interface, servo system and other relevant knowledge. Then it will describe and analyze typical mechatronic system design cases in detail. While in teaching process, we will also adopt course grouping projects to help students to achieve the learning objectives, improve their practical ability, cultivate the international thinking and team cooperation management ability. Furthermore, we believe that this course will also help them to lay a solid foundation for future theoretical and applied research in mechatronic.

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.)

Week	内容
1（2 课时） 1（2 credit hours）	机电一体化概述及系统设计方法 Overview of mechatronics and system design methods
2（2 课时） 2（2 credit hours）	机械系统的结构设计及主要动力学参数 Structural design and main dynamic parameters of mechanical system
3（2 课时） 3（2 credit hours）	机械系统部件的选择计算 Selection and calculation of mechanical system components
4（2 课时）	机械系统执行电动机的选择计算、动力学特性分析

4 (2 credit hours)	Selection calculation and dynamic characteristics analysis of executive motor in mechanical system
5 (2 课时)	机电一体化系统常用传感器、信号放大电路
5 (2 credit hours)	Sensors and signal amplification circuits commonly used in mechatronics systems
6 (2 课时)	信号放大电路、信号调制与解调电路
6 (2 credit hours)	Signal amplification circuit, signal modulation and demodulation circuit
7 (2 课时)	信号的滤波电路、数字式传感器信号检测电路
7 (2 credit hours)	Signal filtering circuit, digital sensor signal detection circuit
8 (2 课时)	人机接口设计
8 (2 credit hours)	User - machine interface design
9 (2 课时)	过程输入通道接口设计
9 (2 credit hours)	Interface design of process input channel
10 (2 课时)	通信原理及常见的串口通信方式
10 (2 credit hours)	Communication principle and common serial communications
11 (2 课时)	CAN 总线通信方式
11 (2 credit hours)	CAN bus communication
12 (2 课时)	电机控制原理及方法
12 (2 credit hours)	Principle and method of motor control
13 (2 课时)	直流电机、舵机的控制方式
13 (2 credit hours)	Control methods of DC motor and servo motor
14 (2 课时)	步进电机的控制方式
14 (2 credit hours)	Control method of step motor
15 (2 课时)	典型机电一体化系统设计与分析
15 (2 credit hours)	Design and analysis of typical mechatronics system
16 (2 课时)	习题讲解与复习
16 (2 credit hours)	Exercise explanation and course review
实验 Experiments	
1. MDK5 开发环境安装与配置 (第 1 周, 2 节课)	
1. MDK5 development environment installation and configuration (week 1, 2 credit hours)	

2. 跑马灯、按键输入实验（第 2 周，2 节课）
2. Marquee lamp and key input experiment (week 2, 2 credit hours)
3. 串口通信、外部中断实验（第 3 周，2 节课）
3. Serial communication and external interrupt experiment (week 3, 2 credit hours)
4. 独立看门狗、窗口看门狗实验（第 4 周，2 节课）
4. Independent watchdog and window watchdog experiments (week 4, 2 credit hours)
5. 定时器中断实验（第 5 周，2 节课）
5. Timer interrupt experiment (week 5, 2 credit hours)
6. PWM 输出实验（第 6 周，2 节课）
6. PWM output experiment (week 6, 2 credit hours)
7. RTC 实时时钟实验（第 7 周，2 节课）
7. RTC real time clock experiment (week 7, 2 credit hours)
8. ADC 实验（第 8 周，2 节课）
8. ADC experiment (week 8, 2 credit hours)
9. DAC 实验（第 9 周，2 节课）
9. DAC experiment (week 9, 2 credit hours)
10. 485 通信实验（第 10 周，2 节课）
10. 485 communication experiment (week 10, 2 credit hours)
11. CAN 通信实验（第 11 周，2 节课）
11. CAN communication experiment (week 11, 2 credit hours)
12. 直流减速电机控制实验（第 12 周，2 节课）
12. Control experiment of DC decelerator motor (week 12, 2 credit hours)
13. 步进电机控制实验（第 13 周，2 节课）
13. Step motor control experiment (week 13, 2 credit hours)
14. 伺服电机控制实验（第 14 周，2 节课）
14. Servo motor control experiment (week 14, 2 credit hours)
15. 课程项目综合测试（第 15、2 节课）
15. Tests of course projects (week 15, 2 credit hours)

16. 课程项目演示与答辩（第 16 周，2 节课）

16. Presentations and defenses of course projects (week 16, 2 credit hours)

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

教材：机电一体化系统设计（第二版）. 曾励, 竺志大. 高等教育出版社, 2020

参考书:

1、机电一体化系统设计（第三版）. 冯浩, 汪建新, 赵书尚, 杨威. 华中科技大学出版社, 2021

2、机电一体化技术与系统（第二版）. 梁景凯, 刘会英. 机械工业出版社, 2022

3、机电一体化原理及应用（第三版）. 吕强, 孙锐, 李学生. 国防工业出版社, 2010

4、STM32F7 开发指南-HAL 库版本_V1.1. 广州市星翼电子科技有限公司.

Textbook: Mechatronics System Design (Second Edition) Zeng Li, Zhu Zhida Higher Education Press, 2020

References:

1. Mechatronics System Design (Third Edition), Feng Hao, Wang Jianxin, Zhao Shushang, Yang Wei Huazhong University of Science and Technology Press, 2021

2. Mechatronics Technology and Systems (Second Edition), Liang Jingkai, Liu Huiying, China Machine Press, 2022

3. Principles and Applications of Mechatronics (Third Edition), Lv Qiang, Sun Rui, Student Li, National Defense Industry Press, 2010

4. STM32F7 Development Guide - HAL Library Version VV1.1 Guangzhou Xingyi Electronic Technology Co., Ltd

课程评估 ASSESSMENT

19. 评估形式 Type	评估时间 of 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				
实验 Experiments		30		
课程项目 Projects		50		
平时作业		10		

Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
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

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