

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	机电系统设计与创新实践 Mechatronics System Design & Innovation
2.	授课院系 Originating Department	创新创业学院 ICOLLEGE
3.	课程编号 Course Code	IN0002
4.	课程学分 Credit Value	2
5.	课程类别 Course Type	通识通修选修课程 General Education (GE) Elective Courses
6.	授课学期 Semester	秋季学期 Fall semester
7.	授课语言 Teaching Language	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 all instructors)	张冬 ZhangDong, 创新创业学院 ICOLLEGE, zhangd6@sustc.edu.cn, 13323587131
9.	实验员/助教、所属学系、联系方式（请列出本课所有教辅人员） Tutor/TA(s), Contact (Please list all)	尹明 YinMing, 创新创业学院 ICOLLEGE, yinm@mail.sustc.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	40

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	16		32		48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	有基本的编程基础（不限编程语言种类） Fundamental programming basics (Any programming languages)				
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>机电系统设计是一门综合性的学科，涉及到机械工程、电子技术、信息技术、传感器技术、自动控制技术、人机工程学、美学等多学科，是多学科知识的综合运用。本课程从机械与电子、工业设计等融合的角度，介绍机电系统的组成原理、设计思想及方法、典型产品的分析等内容，并通过实验和引导性实验强调对学生综合实践能力和工程能力的训练和培养；</p> <p>Mechatronics system design is a comprehensive discipline involving mechanical engineering, electronic technology, information technology, sensor technology, automatic control technology, ergonomics and aesthetics etc., is a comprehensive application of multidisciplinary knowledge. This course introduces the organization principles, design ideas and methods, typical products analysis etc. of the Mechatronics system from the perspective of integration of machinery and electronics, industrial design etc., and emphasizes the training and cultivation of students' comprehensive practical ability and engineering ability through experiments and guided experiments.</p>
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16. 预达学习成果 Learning Outcomes	<p>通过学习本课程，使学生了解和掌握机电系统中常用的机械系统、驱动系统、人机接口、传感系统的工作原理、性能、特点及应用，并结合实验和引导性实验培养学生的机电产品设计能力和新产品开发能力，初步让学生学会设计机电产品。</p> <p>This course can enable the students to understand and master the working principles, performance, characteristics and applications of the mechanical system, driving system, human-machine interfaces and sensing systems which are commonly used in Mechatronics system, train the ability of Mechatronics product design and new product development through experiments and guided experiments, and initially let students learn to design Mechatronics products.</p>
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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.)	
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一、教学日历 Calendar

教 学 内 容	讲授	实验/实践	合计
第一讲：绪论 Lecture 1 Introduction	2	2	4
第二讲：机电系统中的机械装置与设计入门 Lecture 2 Introduction to Mechanical Devices and Design in Mechatronics System	2	6	8
第三讲：机电系统中的执行装置与控制入门 Lecture 3 Introduction to Execution Devices and Controls in Mechatronics System	2	4	6
第四讲：机电系统中的接口技术与控制入门 Session 4 Introduction to Interface Technology and Control in Mechatronics System	2	4	6
第五讲：机电系统中传感器技术与控制入门 Lecture 5 Introduction to Sensor Technology and Control in Mechatronics System	2	8	10
第六讲：工业机器人技术 Lecture 6 Industrial Robotics	2	2	4
第七讲：机电系统设计实践与应用创新 Session 7: Design Practice and Application Innovation of Mechatronics System	4	6	10
合 计	16	32	48

二、课程内容 Content

第一讲 绪论

Lecture 1 Introduction

内容：1、机电系统基本概念；2、机电系统技术的分类与应用；3、机电系统的关键技术；4、典型机电系统案例剖析；5、机电产品设计方法；6、机电系统技术发展趋势。

Contents: 1. Basic concept of Mechatronics system; 2. Classification and application of Mechatronics system technology; 3. Key technologies of Mechatronics system; 4. Example analysis of typical Mechatronics system; 5. Design methods of Mechatronics product; 6. Development trend of Mechatronics system technology.

第二讲 机电系统中的机械装置与设计入门

Lecture 2 Introduction to Mechanical Devices and Design in Mechatronics System

内容：1、机电系统中机械系统的组成及特点；2、机电系统技术对机械系统的基本要求；3、各种常用机械传动部件与执行机构，如齿轮传动、滚珠丝杠、谐波齿轮传动、联轴器、离合器、制动器、导轨的结构型式及基本工作原理；4、实验使用开源的 OPENS CAD 软件对部分基本机构进行设计构建和动画仿真。

Contents: 1. Composition and characteristics of the mechanical system in the Mechatronics system; 2. Basic requirements of the mechanical system for Mechatronics system technology; 3. Structural type and basic working

principles for various common mechanical driving components and actuators, such as gear drive, ball screw, harmonic gear drive, coupling, clutch, brake and guide rail; 4. Use Open source OpenSCAD software for experimental design and animation simulation of some basic mechanisms.

第三讲 机电系统中的执行装置与控制入门

Lecture 3 Introduction to Execution Devices and Controls in Mechatronics System

内容：1、执行装置的概念、伺服系统的结构组成及分类；2、直流伺服系统结构和原理；3、交流伺服系统的分类及应用；4、步进电动机的结构、工作原理及使用特点；5、实验使用 Arduino 进行步进电机开环控制实验、直流电动机的脉宽调速实验和舵机控制实验。

Content: 1. Concept of execution device, structural composition and classification of the servo system; 2. Structure and principle of DC servo system; 3. Classification and application of AC servo system; 4. Structure, working principle and utilization characteristics of stepping motor; 5. Use Arduino to perform open-loop control experiment of stepping motor, pulse width speed control experiment of DC motor and servo control experiment.

第四讲 机电系统中的接口技术与控制入门

Session 4 Introduction to Interface Technology and Control in Mechatronics System

内容：1、接口技术的基本概念、分类；2、人机接口的类型及特点；3、机电接口的类型及特点；4、实验使用 Arduino 进行按键-显示实验、ADC 数据采集实验和 USB 串口通信实验。

Contents: 1. Basic concept and classification of interface technology; 2. Type and characteristics of human-machine interface; 3. Type and characteristics of Mechatronics interface; 4. Use Arduino for key-display experiment, ADC data acquisition experiment, and USB serial communication experiment.

第五讲 机电系统中传感器技术与控制入门

Lecture 5 Introduction to Sensor Technology and Control in Mechatronics System

内容：1、传感器的概念、分类及要求；2、机电系统常用传感器的基本原理、特点及应用；3、实验使用 Arduino 进行温度数据采集实验、光电信号采集实验、超声波传感器实验、压力传感器实验。

Contents: 1. The concept, classification and requirements of sensors; 2. The basic principles, characteristics and applications of sensors used in Mechatronics systems; 3. Experiments using Arduino for temperature data acquisition experiments, photoelectric signal acquisition experiments, ultrasonic sensor experiments, and pressure sensor experiments.

第六讲：工业机器人技术

Lecture 6: Industrial Robotics

内容：1、工业机器人的定义；2、工业机器人的结构组成；3、工业机器人的应用；4、典型的工业机器人系统剖析。

Contents: 1. Definition of industrial robot; 2. Structural composition of industrial robot; 3. Application of industrial robot; 4. Analysis of typical industrial robot system.

第七讲：机电系统设计实践与应用创新

Session 7: Design Practice and Application Innovation of Mechatronics System

内容：1、学习使用激光切割机或者 3D 打印机将机械设计变成实物；2、结合课程前面所学的各种器件和控制方法由学生自行设定应用场景，实现一个类似玩具机械臂、自动绘图仪的小型机电系统并且完成课程报告。

Contents: 1. Learning to use a laser cutting machine or 3D printer to transform the mechanical design into a physical object; 2. Combining the various devices and control methods learned in the course, the students set their own application scenarios to make a small Mechatronics system similar to robotic arm and autoplotter, and complete the course report.

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

教材 Textbook:

《机电一体化系统设计/面向 21 世纪课程教材》，赵松年等，机械工业出版社，2015

参考资料 Reference :

1. 《机电一体化系统设计》，张建民，高等教育出版社，2014（第 4 版）
2. 《Arduino 权威指南》，[美] Michael Margolis 著；杨昆云 译，人民邮电出版社，2015（第 2 版）
3. 《工业机器人设计与应用》，李瑞峰，哈尔滨工业大学出版社，2017

教学评估 ASSESSMENT				
19. 评估形式 Type of Assessment	评估所需时间 Duration	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				
小测验 Quiz				
课程项目 Projects		45%		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final		45%		

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