

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	传感器与执行器 Sensors and Actuators
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	ME321
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	春季学期 Spring
7.	授课语言 Teaching Language	英文 English
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)	胡程志 机械与能源工程系 Chengzhi Hu Department of Mechanical and Energy Engineering
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	40		16		56
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE104 电路基础、EE205 信号和系统 EE104 Fundamentals of Electric Circuits EE205 Signals and Systems				
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

传感器与执行器是机械与能源工程系本科生专业核心课。其他学科专业具备相应基础知识且有兴趣的学生可以选修。本课程的先修课程为电路基础。

本课程的主要任务是通过理论教学环节和实验教学环节使学生掌握常用多种类型传感器的工作原理，基本功能，静态特性，数学模型和动态响应特性、信号分析方法，以及基于传感器获得的数据进行误差分析与处理。实验教学环节培养学生利用 Arduino 作为控制器，从多种传感器获取信息，并在多种执行器平台上完成控制功能。培养学生了解 Arduino 的原理，编程方法；掌握多种传感器的性能、静态与动态特性，使用方法；掌握基于传感器实现执行器的开闭环控制。此外，我课程也将讲授应用与机器人系统的各类驱动器的发展历程，各类驱动器的应用场景，典型驱动器的原理和模型。为以后从事机器人、物联网、机电系统设计等方向的工程技术工作、科学研究工作以及开拓新技术领域奠定基础。

Sensors and Actuators is a major Core course for undergraduate students in the Department of Mechanical and Energy Engineering. Students from other majors who have appropriate basic knowledge and are interested can take courses. The prerequisite course is Fundamentals of Electric Circuits.

The objective of this course is to teach the working principles, basic functions, static characteristics, math model and dynamic responses of several commonly used sensors. Students will also learn skills for signal analysis and error analysis and estimation. The experimental session trains students to use Arduino as a controller, obtain information from multiple sensors, and apply control on different actuator platforms. The course is to make students understand the principles and programming of Arduino; the performance, static and dynamic characteristics of various sensors, and use methods; the open/closed loop control of actuators based on sensors.

This course will also introduce the development of different types of actuators for use in the robotics, the application scenario of different types of actuators, and different principle and model of typical actuators. This course will lay the foundation for future engineering and technical work, scientific research work and the development of new technology fields in the fields of robotics, Internet of things, mechatronics systems, etc.

16. 预达学习成果 Learning Outcomes

通过对本课程的学习，学生将掌握以下几个方面：

- 1.了解传感器与执行器的定义、组成、发展趋势以及应用
- 2.传感器与执行器的基本特性
- 3.不同类型的传感器与执行器原理，测量电路及应用
- 4.理解各类驱动器的基本工作原理和工作特性
- 5.科研表达能力与科研创新能力
- 6.交流：通过口头，视觉和书面交流（包括摘要），以适合于在所引用的期刊上发表或在该领域的会议上发表的方式和格式，交流实验背景，方法，结果和结论。

1. Understand the definition, composition, development trend and application of sensors and actuators

2. The basic characteristics of the sensor and actuators
3. The principle, measurement circuit and application of different types of sensors and actuators
4. Understand the basic working principle and working characteristics of various drivers
5. Scientific research expression ability and scientific research innovation ability
6. Communication: Communicate an experimental and scientific background, methods, results, and conclusions through oral, visual, and written communication, including an abstract, in a style and format suitable for publication in a refereed journal or presentation at a conference in the field.

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
绪论 <ul style="list-style-type: none"> • 传感器与执行器分类 • 传感器与执行器技术发展 Introduction <ul style="list-style-type: none"> • Definition of sensors and actuators and classification • Development of sensor sensors and actuators technology 	传感器的定义、组成、分类、发展趋势 Understand the definition, composition, classification, and the trends of sensors and actuators technology	2
传感器与执行器的基本特性 <ul style="list-style-type: none"> • 静态特性指标 • 动态响应的特性指标 Basic characteristics of sensors and actuators <ul style="list-style-type: none"> • Static characteristics • Characteristics of dynamic response 	了解传感器的静态特性与动态特性，数学模型 Understand the static and dynamic characteristics of sensors and actuators, mathematical models	6
不同传感器原理及应用 <ul style="list-style-type: none"> • 电阻传感器 • 电感传感器 • 电容传感器 Principles and applications of different types of sensors <ul style="list-style-type: none"> • Resistance sensor • Inductive sensor • Capacitive sensors • 	不同种传感器概述工作原理及应用 Overview of different types of sensors and their applications	12
不同传感器原理及应用 <ul style="list-style-type: none"> • 压电传感器 • 磁性传感器 • 光电传感器 Principles and applications of different types of sensors <ul style="list-style-type: none"> • Piezo sensors • Magnetic sensor • photoelectric sensor 	不同种传感器概述工作原理及应用 Overview of different types of sensors and their applications	10
执行器原理及应用 <ul style="list-style-type: none"> • 各类执行器的应用场景 • 典型执行器的原理 Principles and applications of different types of sensors <ul style="list-style-type: none"> • Application scenario of different types of actuators • The principle of typical actuators 	了解机器人的发展史、组成结构以及各类型驱动器的历史背景、应用场景，理解典型驱动器的原理和模型 Understand the historical background and application scenarios of different types of actuators, and principle and model of typical actuators.	8
执行器原理及应用 <ul style="list-style-type: none"> • 典型执行器的数学模型 	了解执行器原理及应用，典型执行器的数学模型，驱动/传感一体化技术	2

<ul style="list-style-type: none"> 驱动/传感一体化技术 Principles and applications of different types of sensors <ul style="list-style-type: none"> The model of typical actuators Integration of sensors and acutators 	Understand the principles and applications of different types of sensors, the model of typical actuators, the integration of sensors and acutators	
实验教学		
<ul style="list-style-type: none"> Arduino 的基本配置 超声传感实验 距离传感实验 光纤传感实验 加速度、角度传感实验 电磁传感实验 <ul style="list-style-type: none"> Basic configuration of Arduino Ultrasonic sensing experiment Distance sensing experiment Optical fiber sensing experiment Acceleration and angle sensing experiments Electromagnetic sensing experiment 	<p>了解 Arduino 的原理，编程方法；掌握多种传感器的性能、静态与动态特性，使用方法；掌握基于传感器实现执行器的开闭环控制。</p> <p>Understand the principles and programming methods of Arduino; master the performance, static and dynamic characteristics of various sensors, and use methods; master the open-closed loop control of actuators based on sensors.</p>	8
学生项目终期汇报 Final report from students	对传感器有新的理解，对存在的问题有自己的解决思路和方法 Have a new understanding of sensor technology, and have their own solutions to existing problems	8

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

Make: Sensors: A Hands-On Primer for Monitoring the Real World with Arduino and Raspberry Pi by Tero Karvinen , Kimmo Karvinen, et al, 2014, ISBN-13: 978-1449368104 Handbook of Modern Sensors: Physics, Designs, and Applications by Jacob Fraden, 2016, ISBN-13: 978-3319193021 《电机学（第七版）》 电子工业出版社 Stephen D. Umans 著，刘新正、苏少平、高琳译
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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		5		Participation in Q&As
小测验 Quiz				
课程项目 Projects		20		Go Forth presentations
平时作业 Assignments		30		Lab assignments and reports
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告		35		Poster presentation and Final

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)**

			paper

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