

## SDM273 智能传感与信号处理教学大纲

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|---------------|-------|
| 1. 2023年春季学期  | 1-5页  |
| 2. 2024年春季学期起 | 6-10页 |

## 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 <b>Course Title</b>	智能传感与信号处理 Intelligent Sensors and Signal Processing
2.	授课院系 <b>Originating Department</b>	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing (SDIM)
3.	课程编号 <b>Course Code</b>	SDM273
4.	课程学分 <b>Credit Value</b>	3
5.	课程类别 <b>Course Type</b>	专业核心课 Major Core Courses
6.	授课学期 <b>Semester</b>	春季 Spring
7.	授课语言 <b>Teaching Language</b>	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） <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	孔贺 副教授 kongh@sustech.edu.cn 系统设计与智能制造学院 KONG He Associate Professor kongh@sustech.edu.cn School of System Design and Intelligent Manufacturing (SDIM)
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>	待公布 To be announced

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
	32		32		64
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE104 电路基础 EE104 Fundamentals of Electric Circuits				
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.	机械与能源工程系 (机械工程, 机器人工程方向) Department of Mechanical and Energy Engineering				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

智能传感与信号检测和处理技术是自动控制系统、电子信息系统、检测装置和仪器仪表等的重要组成部分，是信息的源头。《智能传感与信号处理》课程是自动化类、机械类、测控类等相关专业的专业核心课程，该课程以“传感、检测、误差分析与信号处理”为主线，教学内容涵盖传感器的一般概念与性质、各类常用传感器的功能与原理、量测误差分析与信号处理；其整体内容涉及电学、机械、自控原理等多学科知识的交叉融合。

Intelligent sensing and signal detection/processing technology are important components of automatic control systems, electronic information systems, detection devices and instrumentation, and are the source of information. The course "Intelligent Sensing and Signal Processing" is a major core course for automation, mechanical engineering, measurement and control and other related majors. The course focuses on "sensing, detection, error analysis and signal processing", and the teaching content covers the common concepts and properties of sensors, functions and principles of popular sensors in practice, measurement error analysis and signal processing. The overall content involves the cross-integration of multidisciplinary knowledge such as electrical/electronic engineering, mechanical engineering, and automatic control principles.

#### 16. 预达学习成果 Learning Outcomes

学生完成本课程的学习后，应能够获得如下学习成果：

1. 掌握传感与检测技术的基本概念，检测系统的基本特性，信号分析及其在检测技术中的应用，各种常用传感器的工作原理、测量电路以及应用，测量误差分析和测量数据的基本处理算法，了解现代检测技术的初步知识，并掌握各种常见物理量的测量和应用方法。
2. 要求掌握传感器原理和测量数据处理技术，根据系统的要求和性能指标，能够设计/开发现代测量系统。
3. 能够设计实验方案，完成实验，并能分析实验数据并得出结论，增强撰写报告的能力。
4. 通过本课程的案例设计与分析教学环节，增强自主学习意识。
5. 及时了解传感与检测技术的发展动态，增强自主探索意识和能力。

Upon completion of this course, students should be able to achieve the following learning outcomes:

1. Master the basic concepts of sensing and detection technology, the basic characteristics of detection systems, signal analysis and its application in detection technology, the working principles, measurement circuits and applications of various commonly used sensors, measurement error analysis and the basics of measurement data process algorithms,

understand the preliminary knowledge of modern detection technology, and master the measurement and application methods of various common physical quantities.

2. Master the sensing principle and measurement data processing technology, and be able to design/develop a modern measurement system according to the system requirements and performance indicators.
3. Can design experimental programs, complete experiments, analyze experimental data and draw conclusions, and have the ability to write reports.
4. Through the design project, and case studies, students' self-learning awareness and abilities can be enhanced.
5. Keep abreast of the development of sensing and detection technology, and become more motivated to explore new knowledge and technologies.

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.)**

1. 绪论（2学时）  
基本概念（定义、传感器系统的组成、特点和发展）
  2. 传感器的一般特性（6学时）  
传感器静态特性和动态特性的定义、线性度、灵敏度、精确度、温漂、零漂等，一阶和二阶传感器动态响应及分析
  3. 各类常用传感器的介绍（12学时）  
应变式传感器、电容式传感器、电感式传感器、磁敏式传感器、热电式传感器、光电式传感器、新型传感器等
  4. 特邀报告（共2次报告，2学时）  
智能感知技术在智能交通、智慧城市、智慧医疗中的应用
  5. 误差分析及信号处理（6学时）  
测量误差的定义；测量误差的分类；不同测量误差的处理方式；传感器参数标定；基于最小二乘的误差处理方法；典型案例分析（图像感知系统、声音感知系统的参数标定）
  6. 学生组队报告（4个学时）  
讲解现代科学文献中的传感检测系统原理及应用
  7. 实验部分（32学时）  
多种传感器的基本使用、数据采集与分析；课程设计（设计一个测量系统，如电子秤）
1. Introduction (2 class hours)  
Basic concepts (definition, composition, characteristics and development of sensor systems)
  2. General Characteristics of Sensors (6 class hours)  
Definition of static and dynamic characteristics of sensors, linearity, sensitivity, accuracy, temperature drift, zero drift, etc., dynamic response and analysis of first-order and second-order sensors
  3. Introduction of various common sensors (12 class hours)  
Strain sensors, capacitive sensors, inductive sensors, magnetic sensors, pyroelectric sensors, photoelectric sensors, new sensors, etc.
  4. Invited lectures (2 lectures in total, 2 hours)  
Application of sensing technology in intelligent transportation, smart city, and smart medical care, etc
  5. Error analysis and signal processing (6 class hours)  
Definition of measurement error; Classification of measurement errors; Handling of different measurement errors; sensor parameter calibration; Error processing method based on least squares; Case studies (parameter calibration of image perception system and sound perception system)
  6. Student team presentation (4 class hours)  
Explain the principles and applications of sensing detection systems in modern scientific literature

7. Experimental activities (32 class hours)

Use of various sensors, data collection and analysis; project design (design of a sensing system, e.g., electronic weighting scale)

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

胡向东, 传感器与检测技术, 机械工业出版社, 2018.  
 王俊杰, 传感器与检测技术, 清华大学出版社, 2012.  
 Jacob Fraden, Handbook of modern sensors: Physics, designs, and applications, 3rd Edition, Springer, 2016.  
 Kimmo Karvinen, Tero Karvinen, and Ville Valtokari, Make: Sensors: A Hands-On Primer for Monitoring the Real World with Arduino and Raspberry Pi, Make Community, LLC, 2014.

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		10		
小测验 Quiz				
课程项目 Projects		20		
平时作业 Assignments		15		
期中考试 Mid-Term Test				
期末考试 Final Exam		40		
期末报告		15		



**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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4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业核心课 Major Core Courses
6.	<b>授课学期 Semester</b>	春季 Spring
7.	<b>授课语言 Teaching Language</b>	中英双语 English & Chinese
8.	<b>授课教师、所属学系、联系方式 (For team teaching, please list all instructors)</b>	孔贺 副教授 kongh@sustech.edu.cn 系统设计与智能制造学院 KONG He Associate Professor kongh@sustech.edu.cn School of System Design and Intelligent Manufacturing (SDIM)
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	待公布 To be announced
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	待公布 To be announced

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
	32		32		64
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE104 电路基础 EE104 Fundamentals of Electric Circuits				
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.	机械与能源工程系 (机械工程, 机器人工程方向) Department of Mechanical and Energy Engineering				

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2. 要求掌握传感器原理和测量数据处理技术，根据系统的要求和性能指标，能够设计/开发现代测量系统。
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4. 通过本课程的案例设计与分析教学环节，增强自主学习意识。
5. 及时了解传感与检测技术的发展动态，增强自主探索意识和能力。

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  3. 各类常用传感器的介绍（12学时）  
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  4. 特邀报告（共2次报告，2学时）  
智能感知技术在智能交通、智慧城市、智慧医疗中的应用
  5. 误差分析及信号处理（6学时）  
测量误差的定义；测量误差的分类；不同测量误差的处理方式；传感器参数标定；基于最小二乘的误差处理方法；典型案例分析（图像感知系统、声音感知系统的参数标定）
  6. 学生组队报告（4个学时）  
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  7. 实验部分（32学时）  
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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				
课堂表现 Class Performance		10		
小测验 Quiz		15		
常规实验项目 Projects		30		
平时作业 Assignments		15		
期中考试 Mid-Term Test				
期末考试 Final Exam				

课程项目及期末报告 Final Presentation		30		此部分包括课程项目及项目报告（为集成式设计项目，与常规实验项目不同）
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**

