

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	医学智能传感技术 Intelligent Sensing Technology
2.	授课院系 Originating Department	生物医学工程系 Biomedical Engineering
3.	课程编号 Course Code	BMEB332
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
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)	罗智, 生物医学工程系 Zhi Luo, Department of Biomedical Engineering luoz@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
	48				48
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 None				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 None				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

医学智能传感技术是智能医学工程专业的重要专业必修课。本课程首先讲授人体生理信息产生的原因、传导过程及其与传感器的相互作用，生物医学传感技术的基本特性、工作原理、检测技术等；课程将介绍用于生物医学测量仪器构建所需的各类传感器类型，主要包括物理量传感器、化学量传感器和生物量传感器及其测量方法；更进一步课程将涵盖微纳技术、微流控技术在智能医学传感器中的应用及其材料与加工方式。课程最后讲授各类新型生物医学传感技术，如生物医学传感集成器件、仿生生物传感技术、穿戴式生物医学传感技术、智能传感与临床应用等。通过本课程的学习，要求学生掌握各类生物医学传感器的基本原理和主要测量方法，具备基本的获取生物医学信号的能力，初步掌握生物医学测量系统或仪器构建的技能，并为专业技能培养奠定基础。

“Intelligent sensing technology” is an important course for intelligent medical engineering. First, this course provides an overview of human physiological information, and the interactions between biological systems and sensors. The basic characteristics, working principles, and detection technology of biomedical sensor technologies will be covered. The course introduces various types of sensors and detection methods required for the construction of biomedical instruments, including physical sensors, chemical sensors, biological sensors. Advanced technologies will be discussed such as micro-nano devices, microfluidics as well as related materials and manufacturing methods. Finally, this course introduces several cutting-edge technologies, such as integrated sensor devices, wearable biomedical sensors, intelligent systems for clinical translation. After this course, students are expected to master the basic principles and main measurement methods of biomedical sensors with the ability to obtain biomedical signals, and to construct biomedical measurement related instruments laying the foundation for subsequent professional training.

16. 预达学习成果 Learning Outcomes

1. 学习并掌握生物医学传感和检测技术的学科特点，了解本学科的发展概况和最新研究热点问题。培养学生自主学习和终身学习的意识。
2. 掌握人体生理信息的相关内容，包括身体生理信息与诊断、分子与细胞生物学、生物医学等相关的基础知识。
3. 学习生物医学传感器的先进制造技术、基本性能指标与结构、传感器监测系统性能表征方法等相关知识。
4. 掌握生物医学测量仪器构建所需的各类传感技术，包括物理量传感技术、化学量传感技术和生物量传感技术，要求学生熟悉各类传感器的构造、工作原理和应用领域。
5. 熟悉前沿生物医学传感器集成技术与制造，如纳米生物医学传感技术、穿戴式生物医学传感技术、传感器材料、生物传感器的临床应用等。
6. 通过英语教学，培养学生的专业英语能力，掌握课程核心词汇，能够阅读英语专业文献。

1. Master the characteristics of biomedical sensing and detection technologies. Understand the history and the recent development of the field and keep independent learning and lifelong learning attitude.
2. Master relevant knowledge regarding human physiological information, including biological signals and their diagnosis, basic concepts in molecular and cell biology, and biomedicine.

3. Learn relevant knowledge about advanced fabrication techniques of biomedical sensors, their structures and characterizations methods.
4. Master various sensing technologies required for the construction of biomedical instruments, including physical, chemical, and biological sensing technologies. Students are required to get familiar with the working principles and application fields of various sensors.
5. Become familiar with several types of new biomedical sensing and integration technologies, such as nano-biomedical sensing technologies, wearable biomedical sensing technologies, materials and manufacture technologies, as well as intelligent medical sensing in clinical translation.
6. Get well trained on professional English in biomedical sensing field. Master the core vocabulary of biomaterials science with the ability to read English literature.

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.)

第一章 绪论（2学时）

（本章主要概括介绍生物传感技术的基本概念、发展状况、主要特点和未来发展趋势。）

第二章 人体生理信息与生物医学基础（4学时）

（本章讲述人体各类生理信息，包括其细胞与分子生物学概念、传导过程以及与传感器的相互作用。）

第三章 生物医学传感技术基础（6学时）

（本章讲授生物医学传感器的基本性能指标、信号检测及改进方法、误差分析等基本概念。）

第四章 物理量传感技术（4学时）

（本章介绍如何利用相关物理效应，将被测量的物理量转换成为便于处理的能量与信号形式。包括位移、压力、震动、流量、温度传感器等的基本概念与工作原理。）

第五章 化学量传感技术（4学时）

（本章介绍如何将特定样品中物质的浓度或总成分等化学信号转换成可用的分析信号。课程将介绍识别元件、物理化学换能原理、以及信号处理等概念。）

第六章 生物量传感技术（4学时）

（本章介绍如何利用生物活性物质选择性的识别和测定各种生物化学物质。内容将包含生物分子传感器以及细胞与组织传感器等。）

第七章 微纳传感技术及应用（4学时）

（本章将讲述纳米生物材料结构上的特性以及其与生物体系的相互作用。在此基础上讲授微纳技术如何与物理、化学、生物量传感器相结合及其在不同领域的应用。）

第八章 微流控芯片控制与分析（2学时，本章将邀请一位业内专家共同讲授）

（本章将介绍如何以机电系统技术为基础，通过与分析化学、材料学、生物医学等结合，将化学分析系统从试样处理、分析到检测的全流程实现整体的微型化、集成化与便携化。）

第九章 传感设备材料与制造（4学时）

（本章将讲述传感器的生物相容性问题，包括材料与生物体相互的物理化学反应及其衡量方式，同时介绍各类传统与先进的传感材料加工制造方法。）

第十章 生物医学传感集成（2学时）

（本章将介绍多参数、多功能的生物传感方法，实对人体信息的系统性采集。）

第十一章 仿生生物传感技术（3学时）

（本章将讲述物系统感受外界信号的机制，如视觉、听觉、触觉、嗅觉和味觉等感知机制，并介绍如何模仿其原理开发新型传感器并拓展实际用途。）

第十二章 穿戴式生物传感技术 (6 学时)

(本章介绍如何通过安装在人、动物和物品上的传感器来感知、传递和处理生物信息从而实现健康预警和病情监控。)

第十三章 智能传感与临床 (3 学时)

(本章介绍医用传感技术在临床治疗上的应用以及医药行业相关进展。)

1. Introduction (2 hours)

(This chapter mainly introduces the basic concepts, development, characteristics and future development trends of biosensing technologies.)

2. Human Physiological Information and Biomedicine (4 hours)

(This chapter describes various physiological information of the human body, including the cell and molecular biology concepts, conduction process, and interaction with sensors.)

3. Fundamentals of Biomedical Sensing Technology (6 hours)

(This chapter teaches the basic concepts in performance indicators, signal detection and improvement methods, and error analysis in biomedical sensors.)

4. Physical Sensing Technology (4 hours)

(This chapter introduces how to use related physical effects to convert the measured physical quantities into energy and signal forms that are easy to process. This includes the basic concepts and working principles of displacement, pressure, vibration, flow, and temperature sensors.)

5. Chemical Sensing Technology (4 hours)

(This chapter describes how to convert chemical signals such as the concentration or total component analysis of chemical substances in a specific sample into measurable analytical signals. The course will introduce concepts such as identification, physical and chemical transduction principles, and signal processing.)

6. Biological Sensing Technology (4 hours)

(This chapter introduces how to use biologically active substances to selectively identify and determine various biochemical substances. The lecture will include biomolecular sensors as well as cell and tissue sensors.)

7. Micro-nano Sensing and Applications (4 hours)

(This chapter will describe the structural characteristics of nano-biomaterials and their interaction with biological systems. The lecture teaches how to combine micro-nano technology with physics, chemistry, and biosensors and their applications in different fields.)

8. Microfluidics Control and Analysis (2 hours, This chapter will be co-lectured by an expert in relevant fields)

(This chapter will introduce how to realize the overall miniaturization, integration and portability of the chemical analysis system from sample processing, analysis to detection based on MEMS technology, combined with analytical chemistry, materials science, biomedicine, etc.)

9. Materials and Manufacturing of Biomedical Sensors (4 hours)

(This chapter will describe the biocompatibility of sensors, including the physical and chemical reactions between materials and organisms and their measurement methods. At the same time, it will introduce various traditional and advanced sensor material processing and manufacturing methods.)

10. Biomedical Sensing Integration (2 hours)

(This chapter will introduce the multi-parameter, multi-functional biosensing methods, and the systematic collection of human body information.)

11. Biomimetic Sensing (3 hours)

(This chapter will describe the mechanism by which the physical system senses external signals, such as the perception mechanisms of vision, hearing, touch, smell and taste, and introduces how to imitate its principles to develop new sensors and expand their practical applications.)

12. Wearable Biosensing Technology (6 hours)
(This chapter introduces how to perceive, transmit and process biological information through sensors installed on people, animals and objects to realize health and disease monitoring.)

13. Intelligent Medical Sensing Towards Clinical Translation (3 hours)
(This chapter introduces the application of medical sensor technology in clinical treatment and related progress in the pharmaceutical industry.)

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

《生物医学传感技术》，王平 沙宪政 主编，人民卫生出版社，2018 年第一版。

Smart Sensors, Measurement and Instrumentation, Book Series, Springer, Published 2013-2021

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				
小测验 Quiz				
课程项目 Projects		10		
平时作业 Assignments		10		
期中考试 Mid-Term Test		20		
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

生物医学工程系教学委员会

