

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	生物医学工程实验（一） Biomedical Engineering Laboratory I
2.	授课院系 Originating Department	生物医学工程系 Department of Biomedical Engineering
3.	课程编号 Course Code	BMEB321
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	3 秋
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 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	彭诚, 教学工程师, pengc@sustc.edu.cn PENG Cheng, Engineer, pengc@sustc.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)	20

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			96		96
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.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程为两学期系列课程中的第一个。针对课程 生物医学工程 I (Biomedical Engineering I, BMEB321 请填写课号) 中介绍的生物力学, 生物材料和生物仪器等生物医学工程核心概念, 学生在本课程中得到相应的实验训练。本课程中将学习到的工程方法、分析方法和报告书写等, 是后续课程 (Biomedical Engineering Laboratory II, BMEB322) 的基础, 也是 Capstone 课程生物医学工程设计 I & II (Biomedical Engineering Design I & II, BMEB422 & BMEB423) 的基础

This is the first of a two-semester course sequence in which the students will be exposed to procedures related to the core biomedical engineering concepts covered in BME I (BMEB321): Biomechanics, Biomaterials and Bioinstrumentation. The engineering, analysis and reporting techniques that the students will learn in this course will be the basis for the subsequent lab course Biomedical Engineering Laboratory II, (BMEB322) and, eventually, Biomedical Engineering Design I & II (BMEB422 & BMEB423).

16. 预达学习成果 Learning Outcomes

本课程是学生在应用层面, 利用定量工程手段研究生物现象的入门课程。本学期的课程中, 将介绍一些重要的基本技能, 即, 基本实验设计, 信号采集、分析和计算机仿真的软硬件工具。

除此之外, 学生在实验中还将学习使用较为专业的实验工具, 例如荧光显微镜, 数字图像处理技术, 细胞生物学和细胞培养, 生物医学仪器, 生物力学测试, 和微加工等。完成本课程之后, 学生将:

1. 熟悉掌握实验设计方法, 能够基于实验结果总结实验结论
2. 熟悉实验设备, 包括基本生物力学测试设备, 信号采集软硬件, 和细胞培养设备等
3. 学会进行实验记录
4. 能够在实验报告中简洁地展示实验数据和实验结论
5. 能够有效的进行团队协作, 以解决实验中的问题。

In this course, the students will begin the exploration of biological phenomena at a practical level using quantitative engineering approaches. This semester will provide an introduction to

essential general skills, i.e., basic design in experimentation; hardware and software tools used for data acquisition; analysis and computer simulations. Additionally, the students will be exposed to more specific laboratory tools such as fluorescent microscopes, digital image processing techniques, cell biology and culture, biomedical instrumentation, and biomechanical testing. Upon completion of this course the students should be:

1. Adept at experimental design and formulation of conclusions based on empirical results;
2. Familiar with laboratory equipment, including basic biomechanical test setups, signal acquisition hardware and software, and equipment for performing cell culture;
3. Able to maintain a standard laboratory notebook;
4. Able to concisely present data and conclusions in a lab report
5. Able to effectively work in teams to solve laboratory challenges

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.)

Lab 0. （4学时）课程介绍，显微镜基本操作； Course Introduction and Microscope manipulation Introduction

Lab 1. （12学时）显微镜成像； Introduction to Microscopy

- (1). Procedure 1: 测量显微镜真实放大倍数; Measure the True Magnification of Objectives
- (2). Procedure 2: 修改物镜的数值孔径; Alter the Numerical Aperture of an Objective
- (3). Procedure 3: 相差显微成像; Phase Contrast Microscopy
- (4). Procedure 4: 荧光显微成像; Fluorescence Microscopy

Lab 2. （16学时）生物力学测试； Biomechanical Testing

- (1). Procedure 1: 金属拉伸试验; Tensile tests - metal
- (2). Procedure 2: 聚合物拉伸试验; Tensile tests - polymer
- (3). Procedure 3: 金属三点弯曲试验; 3-Point Bending Tests - metal
- (4). Procedure 4: 骨头三点弯曲试验; 3-Point Bending Tests - bones

Lab 3. （20学时）生物医学仪器； Bioinstrumentation

- (1). Procedure 1: 正相放大器/反相放大器; Non-Inverting or Inverting Amplifier
- (2). Procedure 2: 用仪用放大器测量进行差分测量; Instrumentation Amplifier for Differential Measurement

- (3). Procedure 3: 三运放仪用放大器; Three-amp instrumentation amplifier
- (4). Procedure 4: RC 滤波器 - 无源低通滤波器; RC Filter - Passive Low Pass Filter
- (5). Procedure 5: RC 滤波器 - 无源带通滤波器; RC Filter - Passive Bandpass
- (6). Procedure 6: 有源放大器 - 带通滤波器; Active filter - bandpass
- (7). Procedure 7: 心电图测量; Electrocardiogram Measurement

Lab 4. (16 学时) 生物医学信号采集和处理; Biosignal Acquisition and Processing

- (1). Procedure 1: 心电信号处理、Matlab GUI; ECG Signal Processing and Acquisition GUI
- (2). Procedure 2: 用自行设计的 GUI 检测人体 ECG 信号; Using Your GUI to Measure ECG from a Human Subject

Lab 5. (12 学时) 细胞培养基础; Cell Culture Basics

- (1). Procedure 1: 贴壁细胞重悬; Derivation of Cell Stock Solution
- (2). Procedure 2: 细胞计数; Cell Counting Using a Hemocytometer
- (3). Procedure 3: 细胞 3D 培养; Seeding Cells into a 3-D Gel
- (4). Procedure 4: 环境溶液对细胞存活率的影响 Effects of Bathing Solution on Cell Viability

Lab 6. (12 学时) 生物材料和给药; Biomaterials and Drug Delivery

- (1). Procedure 1: 配置溶液; Solution Preparation
- (2). Procedure 2: 海藻酸小球的制作; Alginate Bead Fabrication
- (3). Procedure 3: 海藻酸胶囊的制作; Alginate Capsule Fabrication
- (4). Procedure 4: 构建标准浓度-吸光度曲线 Construct a Standard Curve
- (5). Procedure 5: 测量海藻酸小球/胶囊中的染料释放曲线 Measure Dye Release from Alginate Beads and/or Capsules

Final Presentation (4 学时) 期末报告

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

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		10		
小测验 Quiz		10		
课程项目 Projects				
平时作业 Assignments		50		
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation		15		
其它（可根据需要 改写以上评估方 式） Others (The above may be modified as necessary)		5		

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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