

## 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.	<b>课程名称 Course Title</b>	生物医学材料基础 Fundamentals of Biomedical Materials
2.	<b>授课院系 Originating Department</b>	生物医学工程系 Biomedical Engineering
3.	<b>课程编号 Course Code</b>	BMEB214
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业基础课 Major Foundational Courses
6.	<b>授课学期 Semester</b>	秋季 Fall
7.	<b>授课语言 Teaching Language</b>	英文 English
8.	<b>授课教师、所属学系、联系方式 Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	张博, 生物医学工程系, 电子邮箱: <a href="mailto:zhangb3@sustech.edu.cn">zhangb3@sustech.edu.cn</a> Bo Zhang, Department of BME, Email: zhangb3@sustech.edu.cn
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>	

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
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	生物材料与组织工程 Biomaterials and Tissue Engineering				
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

生物医学材料基础是生物医学工程以及与材料科学相关的重要专业基础课程，课程首先讲授材料科学的基础知识，包括原子与分子结构、晶体结构、相图、材料的基本结构与基本性能等。课程进一步介绍与生物医用材料相关的生物学基础知识，特别是核酸与蛋白质结构、细胞结构与功能、生物相容性等；课程最后讲授生物材料在疾病诊断、影像以及治疗领域的应用，重点讲述材料制备工艺、材料表征方法、以及材料微观结构与材料性能间相互关系。通过本课程的学习，学生将具备生物医用材料研究和应用的相关基础知识，理解生物材料的成分-结构-性质-性能之间的关系，并为后续专业课学习奠定基础。

“Fundamentals of Biomedical Materials” is an important course for the specialty of biomedical engineering and other specialties related to biomaterials. First, this course provides a general understanding regarding the fundamentals of materials science, including atomic and molecular structures, crystal structures, phase diagram, material structure and properties. Next, this course will give overview on the biomedical background such as nucleic acid and protein structures, cellular structures and functions, biocompatibility and biomaterial evaluations. Finally, this course introduces the application of biomedical materials in disease diagnostics, imaging and treatment, focusing on the fabrication, characterization of materials, and the relationship between structure and properties. Through this course, the students will grasp the basic knowledge of biomedical materials for research and application, understand the relationship of compositions, structures, properties and performance. This course will lay a foundation for the students' junior and senior studies in the field of biomedical engineering or material sciences.

#### 16. 预达学习成果 Learning Outcomes

1. 学习材料科学基础理论，掌握化学键、晶体结构、相图、相变、材料基本结构和物理性质等基础理论知识。
2. 掌握生物材料相关的基本生物学知识，包括核酸与蛋白结构、细胞结构与功能、生物相容性评价等。
3. 学习材料结构表征方法，包括材料成分结构测试技术、波谱分析技术、微观结构表征技术。
4. 掌握材料性质表征方法，包括力学性质、电学性质、光学性质、声学性质、热学性质等，具备分析材料结构与性能之间关系的基本能力。
5. 熟悉几类主要生物材料包括金属、陶瓷、高分子、水凝胶、以及纳米生物材料的性能特征及生物应用。
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。
7. 介绍生物医学材料科学的发展历史和动向，培养学生自主学习和终身学习的意识。

1. Master the basic theories of materials science, and to grasp the knowledge of atomic structure and bonds, crystal structure, phase diagram, phase transformation, materials structures and properties.
2. Grasp the biological knowledge regarding the biomaterials, including nucleic acid and protein structures, cellular structures and functions, biocompatibility and biomaterial evaluations.
3. Learn the analytical techniques for the compositions and structures of the biomaterials, master the analytical tools of spectroscopy and microstructures.
4. Master the characterization techniques regarding the mechanical, electronic, optical, acoustic, and thermal properties

of materials. Understand the relationship of structures, microstructures, and performance of materials.  
 5. Understand the properties and applications of several types of biomaterials, including metallic biomaterials, ceramic biomaterials, polymeric biomaterials, hydrogels, and nanoscale biomaterials.  
 6. To cultivate the professional English ability through English teaching. Master the core vocabulary of biomaterials science and read English professional literature.  
 7. To introduce the development history and trend of biomaterial science, and to cultivate the awareness of independent learning and lifelong learning.

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 Introduction (2 学时)**

介绍生物医学材料的历史与发展进程，课程安排和考核方式，必要基础知识点讲解

To introduce the history and milestones in the development of biomedical materials, introduce course arrangement and evaluation scheme, lecture on prerequisite knowledge.

**第二章 原子与分子结构 Atomic and molecular structures (4 学时)**

讲解原子结构、电子能级排布、元素周期表、化学键、分子结构等

To introduce atom structure, electron configuration, element table, chemical bond, molecular structure, etc.

**第三章 晶体结构 Crystal structures (3 学时)**

讲解晶体结构、晶格、基元、米勒指数、晶面等概念

To introduce crystal structure, lattice, basis, miller indices, crystallographic planes, etc.

**第四章 陶瓷与高分子结构 Ceramic and polymer structures (2 学时)**

讲解陶瓷与高分子材料的概念和基本结构

To introduce ceramics and polymer, and their structures.

**第五章 相图和相变 Phase diagram and Phase Transformation (3 学时)**

讲解相图的概念和术语、相图的解读，相变的概念和速率等

To introduce concept of phase diagram and terms, interpretation of phase diagram, concept of phase transformation and kinetics.

**第六章 纳米材料 Nanomaterials (3 学时)**

讲解纳米材料的概念、结构和发展历史

To introduce concept of nanomaterials, their structures and history of development.

**第七章 核酸、蛋白与细胞结构 Nucleic acid, protein and cell structures (3 学时)**

讲解 DNA、RNA、蛋白质的分子组成和结构特性，细胞结构与功能

To introduce the molecular composition of DNA, RNA and protein, and their structures, cellular structure and function.

**期中复习与讨论 Mid-term review and discussion (2 学时)**

**第八章 材料结构测试方法 Characterization techniques of material structures (6 学时)**

介绍 2-7 章材料的结构测试方法及原理

To introduce the structure characterization method and principles for materials covered in chapter 2-7.

**第九章 材料的力、热、声、光、电学性质 Material properties: mechanical/thermal/acoustic/optical/electrical (3 学时)**

介绍材料的力、热、声、光、电学性质及与结构之间的关系

To introduce the mechanical/thermal/acoustic/optical/electrical properties of materials, and their relationship to structure.

**第十章 材料性质表征技术 Characterization of Material Properties (6 学时)**

介绍材料的力、热、声、光、电学性质的表征技术及原理

To introduce the mechanical/thermal/acoustic/optical/electrical characterization techniques and principles.

**第十一章 生物医学基础及生物相容性评价 Biomedical background and biocompatibility (3 学时)**

介绍生物医学基础知识及材料的生物相容性评价

To introduce the basic biomedical knowledge and biocompatibility evaluation of materials.

**第十二章 材料在疾病诊断和影像学中的应用 Application of materials in *in vitro* diagnostics and imaging (3 学时)**

介绍材料在疾病诊断和影像学中的典型应用和发展方向

To introduce the typical application of materials in *in vitro* diagnostics and imaging, and future directions.

**第十三章 材料在疾病治疗领域的应用 Application of materials in disease treatment (3 学时)**

介绍材料在疾病治疗中的典型应用和发展方向

To introduce the typical application of materials in disease treatment, and future directions.

**期末复习与讨论 Review and discussion (2 学时)**

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

1. 材料科学基础, 潘金生、全建民、田民波编著, 2011, 清华大学出版社。
2. 生物材料学, 李晓明、郑丽莎编著, 2020, 高等教育出版社。

**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		5%		

课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		15%		
期中考试 Mid-Term Test		30%		
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**