

## 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>	微纳机电系统原理 Introduction to MEMS and NEMS
2.	授课院系 <b>Originating Department</b>	深港微电子学院 School of Microelectronics
3.	课程编号 <b>Course Code</b>	SME318
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)	1. 汪飞, 副教授, 深港微电子学院 办公室: 崇文智园 504 室/工学院北楼 122 Email: <a href="mailto:wangf@sustech.edu.cn">wangf@sustech.edu.cn</a> 电话: 0755-8801-0187  1. WANG Fei, Assoc. Prof., School of Microelectronics Office: Room No. 504, Chongwen iPark / North Tower 122, COE Email: <a href="mailto:wangf@sustech.edu.cn">wangf@sustech.edu.cn</a> Telephone: 0755-8801-0187
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	无 NA / 待公布 To be announced / 已确定的实验员/助教联系方式 Please list all Tutor/TA(s)  待公布 To be announced
10.	选课人数限额(可不填) <b>Maximum Enrolment</b>	30

(Optional)

11. 授课方式

Delivery Method

学时数

Credit Hours

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

 12. 先修课程、其它学习要求  
 Pre-requisites or Other Academic Requirements

PHY106大学物理(下) College Physics II

 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

本课程主要介绍了典型微纳机电系统的传感器、执行器的运行原理、微纳机电系统设备的设计和制造工艺。除了介绍理论模型之外，这门课程还会着重考察微纳机电系统产品在电子、传感器、通信和生化医疗工程上的商业化应用。本课程涵盖的内容包括许多电子与机械传感机制（电容、压电、压组、电磁和电热）、微纳机电制造技术（硅衬底与表面微加工，平面薄膜处理，纳米材料合成与生长）。微纳机电器件的计算机辅助设计也将在课程介绍微机电系统的布局和多物理场仿真软件的时候使用到。

Micro electro mechanical systems (MEMS) and Nano electro mechanical systems (NEMS) are emerging technologies with increasing applications in handheld devices and miniature distributed systems. This course introduces 1) the operation principles of typical MEMS/NEMS transducers and sensors, and 2) the design and fabrication of MEMS/NEMS devices. In addition to theoretical modelling, this course emphasizes on the exploration of commercially viable MEMS/NEMS products for applications in electronics, sensors, communications, and biomedical engineering.

Topics covered in this course include various transduction and mechanical sensing mechanisms (capacitive, piezoelectric, piezoresistive, magnetic, and thermal), and MEMS/NEMS fabrication technologies (silicon bulk and surface micromachining, planar thin-film processing, wafer bonding, etching, and lithography). Computer-aided design of MEMS/NEMS devices are discussed through MEMS/NEMS layout and multi-physics simulation software. Upon completion, this course enables students to have an in-depth understanding of many MEMS products – accelerometers, gyroscopes, RF MEMS devices, micro-optical devices, and micromachined medical components. It also provides students with the knowledge and skills to design and optimize novel MEMS/NEMS products for new applications.

16. 预达学习成果 Learning Outcomes

学生在按要求学习完本课程之后，将具备以下能力：

1. 理解 MEMS/NEMS 器件的设计、开发、应用流程；
2. 熟悉多种 MEMS/NEMS 器件如：加速度计、陀螺仪、压力传感器等工作原理；

3. 设计 MEMS/NEMS 器件如：加速度计、陀螺仪、压力传感器等；
4. 理解并应用主流微纳加工工艺；
5. 针对新应用领域的 MEMS/NEMS 器件提出新颖设想

After completing this course, the students will be able to:

- 1) Understand overall flow of development of application of MEMS/NEMS
- 2) Familiarize themselves to various MEMS/NEMS devices such as accelerometers, gyroscopes, pressure sensors and etc.
- 3) Design MEMS devices such as accelerometers, gyroscopes, pressure sensors and etc.
- 4) Apply major fabrication techniques used in the MEMS/NEMS field to identify proper fabrication methods to implement the designed MEMS/NEMS devices
- 5) Propose creative ideas using micromachining and MEMS/NEMS devices in new applications

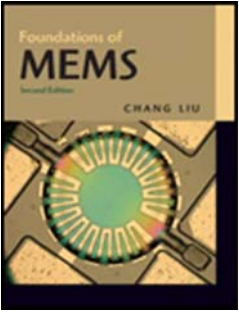
17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

**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.)**



	Topics	Reading	Notes
Week 1	Syllabus and course introduction; Overview of MEMS/NEMS technology – history, application	Chapter 1	HW1
Week 2	Review of electrical and mechanical concepts	Chapter 3	HW2
Week 3	Electrostatic sensing and actuation	Chapter 4	
Week 4	Thermal sensing and actuation	Chapter 5	HW3
Week 5	Piezoresistive sensors	Chapter 6	
Week 6	Piezoelectric sensing and actuation	Chapter 7	HW4
Week 7	Magnetic actuation	Chapter 8	
Week 8	Other sensing and actuation mechanisms	Chapter 9	HW5
	<b>Midterm Exam</b>		
Week 9	Introduction to microfabrication	Chapter 2	
Week 10	Silicon bulk micromachining and anisotropic etching	Chapter 10	
Week 11	Silicon surface micromachining	Chapter 11	HW6
Week 12	Polymer MEMS	Chapter 13	
Week 13	Power MEMS		
Week 14	MEMS/NEMS gas sensors		
Week 15	Seminar Discussion on MEMS/NEMS Frontier (TBD)		
Week 16	Seminar Discussion on MEMS/NEMS Frontier (TBD)		

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

	<p><b>Foundations of MEMS</b>          Author: Chang Liu          Edition: 2<sup>nd</sup>          Publisher: Prentice Hall          Publication Date: March 18, 2011          ISBN-10: 1441981632          ISBN-13: 978-1441981639</p>
	<p><b>Microsystem Design</b>          Author: Stephen D. Senturia          Publisher: Kluwer Academic Publishers;          Publication Date: 1st ed. 2000. Corr. 2nd printing 2004          ISBN: 0792372468</p>
	<p>材料力学          刘鸿文 (编者)          出版社: 高等教育出版社;          第5版 (2011年1月1日)          ISBN: 9787040308952</p>

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		
课程项目 Projects		40		
平时作业 Assignments		10		
期中考试 Mid-Term Test		20		
期末考试 Final Exam				
期末报告 Final Presentation		20		
其它 (可根据需要 改写以上评估方				

式)  
Others (The  
above may be  
modified as  
necessary)

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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**

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