ENG ME 555/MS 555 MEMS: Fabrication and Materials

2008-2009 Catalog Data:

ENG ME 555/MS 555 MEMS: Fabrication and Materials Prereq: graduate status or consent of the instructor. This course will explore the world of microelectromechanical devices and systems (MEMS). This requires an awareness of design, fabrication, and materials issues involved in MEMS. We will go over this through a combination of lectures, case studies, and individual homework assignments. The course will cover fabrication technologies, material properties, structural mechanics, basic sensing and actuation principles, packaging, and MEMS markets and applications. The course will emphasize the fabrication and materials of MEMS. This is not because the other parts aren't important. Instead, it is because with fabrication and materials expertise there is something concrete you can do that will always help. When we exam special topics and case studies, a lot of these other pieces will be put together. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: There is no standard textbook. We will use a combination of materials from books, web sites, monographs, journal papers, and conference proceedings. Two major reference books are: (1) Microsystem Design, Stephen D. Senturia, Kluwer Academic Publishers, 2001, and (2) Fundamentals of Microfabrication, Marc J. Madou, CRC Press LLC, 2002.

Coordinator: Xin Zhang, Associate Professor, Mechanical Engineering

Prerequisites by topic: None

Goals:

To explore the world of microelectromechanical systems (MEMS) by emphasizing the state-of-the-art science and technology in fabrication and materials of MEMS.

Course Learning Outcomes:

As an outcome of completing this course, student will:

- i. Introduction to the field of MEMS
- ii. Grain a knowledge of basic approaches for MEMS design
- iii. Gain a knowledge of state-of-the-art lithography technology for MEMS
- iv. Introduction to new materials for MEMS
- v. Understanding materials science of thin films for MEMS applications
- vi. Understanding of state-of-the-art micromachining and packaging techniques
- vii. Develop experience on Optical MEMS for optical applications
- viii. Develop experience on Power MEMS for power generations
- ix. Development experience on bio MEMS for bio medical applications
- x. Develop a good vision to the future of micro science and technology

Program:	А	В	С	D	Е	F	G	Н	Ι	J	Κ	L	Μ	Ν
Course:	vii,	ii,	ii,	vi,	vi,	i, ii,	i-x	i-x	vii-	vi-	ii-	ii,	ii,	ii, vi,
	viii,	vii-	vi-	vii,	vii,	vi-x			х	х	vi	vii-	viii	vii,
	ix	ix	ix	ix	ix							ix		ix
Emphasis :	3	3	4	5	3	3	5	5	4	5	4	3	2	3

Topics (approximate time spent topic varied from 0.25 to 2 weeks)

- 1. Introduction to MEMS
- 2. Lithography and Soft Lithography
- 3. Materials and Materials Properties in MEMS
- 4. Bulk Micromachining
 - a. Dry Bulk Micromachining
 - b. Wet Bulk Micromachining
- 5. Surface Micromachining
- 6. Wafer Bonding and Packaging
- 7. MEMS Design and Design Tradeoffs
- 8. Fundamentals in MEMS:
 - a. Electronics
 - b. Structures and Elasticity
 - c. Fluids and Mass transport in liquids
- 9. Special Topics
 - a. Mechanical Sensors
 - b. Mechanical Actuators
 - c. Microfluidic Devices
 - d. Optical Microsystems
 - e. Biological Transducers
- 10. Invited Lectures
- 11. Presentations by Students
 - a. Case Study Presentations by Students
 - b. Midterm Presentations by Students
 - c. Final Presentations by Students

Contribution of Course to Meeting the Professional Component:

Engineering topics: 100%

Status of Continuous Improvement Review of this Course:

Prepared by: Professor Xin Zhang Date: April 10, 2009