ENG ME 579/EC 579 Microelectronic Device Manufacturing

2008-2009 Catalog Data:
ENG ME 579/EC 579 Microelectronic Device Manufacturing Prereq: graduate standing plus an undergraduate course in semiconductors at the level of ENG EC 410, EC 453, EC 471, CAS PY 313, or PY 354, or consent of instructor. Physical processes and manufacturing strategies for the fabrication and manufacture of microelectronic devices. Processing and device aspects instrumental in silicon, including the fabrication of doping distributions, etching, photolithography, interconnect construction, and packaging. Future directions and connections to novel devices, MEMS, photonics, and nanoscale structures will be discussed. Emphasis will be on "designing for manufacturability." The overall integration with methods and tools employed by device and circuit designers will be covered. Same as ENG EC 579; students may not receive credit for both. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: "Fundamentals of Semiconductor Devices," by Betty Anderson and Richard Anderson.
Recent microelectronic business case studies, mostly from Harvard Business School Publishing.
Current news articles on microelectronic technology developments

Coordinator: Daniel Cole, Associate Professor, Mechanical Engineering

Prerequisites:
1. Graduate standing plus an undergraduate course in semiconductors at the level of SC 471, CAS PY 313, or PY 354; or SC 575; or consent of instructor.

Goals:
The intent of this course is to provide an overall view of the microelectronics industry, emphasizing semiconductor processing, device design, device operation, and circuit integration, all from the perspective of obtaining an improved manufacturable product. Most semiconductor related courses focus on one of these aspects, without aiming for a full integration of the technology development to enable high yield, fast devices, and low priced products to be obtained. A key emphasis now being recognized in the microelectronics industry is the need to "design for manufacturability" right from the very beginning of the development of a new technology generation, rather than designing first, and later worrying about this important aspect later. A number of examples will be discussed that emphasize the change in business practices now taking place in the microelectronics industry to incorporate this new attitude. Connections will be made throughout the course on how the microelectronics industry is evolving, with directions and connections to new innovative technologies, including novel semiconductor devices, MEMS, photonics, and nanoscale devices. Embracing solid manufacturing practices will be essential for these new and exciting technologies to reach their full potential in the rapidly changing technology business market.

Course Learning Outcomes:

As an outcome of completing this course, students will:

i. Learn about key aspects of the microelectronics industry, from device design, to processing, to photolithography, to manufacturing and packaging. Students will come out knowing the core processes of ion implantation, diffusion, oxidation, deposition, etching, including the fundamental physical mechanisms, and the necessary understanding for using these processes in a manufacturing environment.

ii. Study some important business case studies in microelectronics, that strongly depended on the rapidly changing technology in this area, merged with the business climate that these cases studies occurred in.

iii. Become familiar with a wide range of both conventional & novel semiconductor devices.

iv. Learn in detail many of the core problems involved with MOSFET technology, and the technology problems encountered in the continuing push on scaling and miniaturization.

v. Study in detail a specific class project of the student's choosing (as approved by the instructor), and write an in-depth report on this subject, and present findings.

vi. Learn about the "design for manufacturability" issues that are key in microelectronics.

vii. Learn about most of the economic and business drivers of the microelectronics industry.

viii. Become introduced to the related larger scale domain of MEMS, and the smaller scale realm of nanoelectronics, and the relationships between products in these areas to products in microelectronics.

Course Learning Outcomes mapped to Program Outcomes:

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i		iii	v	i-iv, vi,viii	ii,v,vi	v	ii,v, vi,viii	ii,v, vi,viii	ii,v, viii	i	i,iii,iv	i,iii,iv	i,iv
Emphasis:	4	1	3	3	3	3	4	4	5	5	3	3	3	3

Topics (time spent in weeks):

1. Initial overview of key components in microelectronics industry (1)
2. Silicon processing (3 weeks) (3) Device operation (3)
3. Photolithography processing (1.5)
4. Interconnect processing (1)
5. Connections to device and circuit design (1)
6. Packaging (1)
7. Testing and reliability (.5)
8. Future technologies to be incorporated into manufacturable schemes, including nanoelectronics, optoelectronics, and MEMS (2)
9. Presentations by students on special topics agreed upon with instructor by middle of semester (1)

Contribution of Course to Meeting the Professional Component:

Engineering topics: 100%

Status of Continuous Improvement Review of this Course:

Prepared by: Professor Daniel C. Cole Date: 5/15/09