Boston University
College of Engineering

Course Number: ME 579, cross-listed as EC 579, usually taught each spring

Course Title: Microelectronic Device Manufacturing

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The classes will be on Tuesday and Thursday from 6-8 pm.

My **office hours** will be: 10:30-noon on Wednesday and Thursday in room 135, at 15 Saint Mary's. Please feel free to contact me by email or phone to arrange to meet with me at other times, or, just stop by and see if I am free.

Please note: This course is often taken by students in all three departments, since micro and nano electronic technology has come to be used in so very many fields. For example, take bioengineering: much of the advanced imaging, surgical methods, instrumentation, and analysis in this area would not be possible without microelectronics.

You need the usual set of undergraduate math, and undergraduate physics. You do not need to know semiconductor physics. This will material will be taught as part of the course. You will learn about the engineering and science end, as well as the business end. The course greatly illustrates the use of innovation, since this field of micro and now nanoelectronics has continued to prosper by repeated new innovative methods to overcome barriers.

Course Description/Catalog Data:

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.

Prerequisite Course(s): Senior or graduate standing in engineering, or consent of instructor.

Textbooks:

(1) Main material will be from class notes. If you would like additional background material, here are several fine sources:

- "Fundamentals of Semiconductor Devices," by Betty Anderson and Richard Anderson.
- "Fundamentals of Modern VLSI Devices," by Yuan Taur and Tak H. Ning, 2009.
- "Fundamentals of Microelectronics," Behzad Razav, 2008.

Alternatively, for just general good background, the following advanced undergrad book is very good.

- Solid State Electronic Devices (6th Edition) by Ben G. Streetman.

(2) Recent microelectronic business case studies, including:

(1) "Reversal of Fortune? The Recovery of the U.S. Semiconductor Industry," by Jeffrey T. Macher, D. Mowery and D. Hodges, 1998, 29 pages, HBSP, Case CMR138.

(2) "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics," by Peter C. Grindley, David J. Teece, date 1997, 35p, product number CMR074.

(3) "Whither Moore's Law: The Future of Semiconductors," by Clayton M. Christensen, Scott D. Anthony, Erik A. Roth , date 2004, 25p, product #1751BC.

(4) "Taiwan Semiconductor Manufacturing Co.: The Semiconductor Services Company," by Hau Lee, Seungjin Whang, Shiri Shneorson, date 2006, 27p Product # GS40.

(5) "The "Non-Globalization" of Innovation in the Semiconductor Industry," by Jeffrey T. Macher, David C. Mowery, Alberto Di Minin, Date: Nov 1, 2007 Product Number: CMR387 Length: 27p

(3) Current news articles on microelectronic technology developments, such as new devices and new business directions. These news articles will be covered as they happen, to help foster interest and awareness of the rapidly changing microelectronics industry.

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.

Grading:

Two quizzes, one about ¼ way in and the other about ¾ way into course. Dates will be announced. The intent is to provide a feel for midterm and final	10%
Midterm	30%
Final	30%
Project	30%

Lectures and class activities will require 4 hours per week.

Topics

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

Other helpful books:

(1) “Introduction to Micro Fabrication,” by Sami Franssila, Wiley, 2004, ISBN 0-470-85106-6.

(2) “Advanced Semiconductor Fundamentals,” 2nd ed., by Robert Pierret, Prentice-Hall, 2002, ISBN 013061792X.