

COE 3002 – Introduction to the Microelectronics and Nanotechnology Revolution

Background

This CoE course is intended to support both the new CoE's and CoM's *Technology and Management Program* (1st priority) and the *Georgia Tech Honors Program* (2nd priority). It will also be available as an institute-wide CoE elective. It will expose UG students with little or no ECE background to a high-level understanding of the microelectronics and nanotechnology revolution and its global impact on both technology and society. Engineering, management, and science students will comprise the class, and by its nature it will be highly interdisciplinary in its appeal. The course has been endorsed by Mark Ferguson (Director of the *Technology and Management Program*), and Monica Halka (Associate Director of the *Honors Program*), as well as Gary May in ECE. It is the *Technology and Management Program's* desire that this be offered as a formal course and not simply as a special elective topic in order to support their envisioned minor in T&M – hence the course request form. The course will be first offered in the Fall of 2008, and will use my new book, Silicon Earth: An Introduction to the Microelectronics and Nanotechnology Revolution (Cambridge 2008).

Topical Outline

The Communications Revolution

- The Big Picture
- Global Information Flow
- Evolutionary Trends: Moore's Law
- Silicon: The Master Enabler
- Micro/Nanoelectronics at the State-of-the-art: 90 nm CMOS Technology
- Seeing Versus Imaging the Infinitesimal
- The Micro/Nanoelectronics Distance, Time, Frequency, and Energy Scales
- A Little History

Widget Deconstruction #1: Cell Phone

- How Do They Do What They Do?

Semiconductors

- What Makes Semiconductors So Special?
- Crystal Structure and Energy Bands
- Electrons and Holes
- Moving Charge Around in Semiconductors

Widget Deconstruction #2: USB Flash Drive

- How Do They Do What They Do?

Micro/Nanoelectronics Fabrication

- The IC Fabrication Facility
- Crystal Growth and Epitaxy
- Doping: Diffusion, Implantation, and Annealing
- Oxidation and Film Deposition
- Etching and Polishing
- Photo-lithography
- Metalization and Interconnects
- Building Mr. Transistor
- IC Packaging

Transistors

- Why Are Transistors So Darn Useful?
- The pn Junction
- The BJT
- The MOSFET

Widget Deconstruction #3: GPS

- How Do They Do What They Do?

Microtools and Toys: MEMS, NEMS, and BioMEMS

- Micro-Intuition and the Science of Miniaturization
- Micromachining Silicon and MEMS
- Cool App #1 -- MEMS Accelerometers

Photonics

- The Nature of Light
- Getting Light In and Out of Semiconductors
- Photodetectors and Solar Cells
- CCD Imagers, CMOS Imagers, and the Digital Camera
- LEDs, Laser Diodes, and Fiber Optics
- CDs, DVDs, and Blu-ray

The Nanoscale World

- Darwinian Evolution in Microelectronics
- Buckyballs, Carbon Nanotubes, and Graphene
- Spintronics, Nano-materials, and Self-Assembly
- Bionic Man: The Merger of Biology, Medicine and Micro/Nanoelectronics

“Round-Table” Group Discussion Topics (to be selected from the following list)

- The Internet: Killer App ... With a Dark Side
- Electronic Addictions: E-mail, Cell Phones, i-Pods, and Other Toys
- Gaming and Teen Violence: A Causal Link?
- The New Workaholic: Impact on Family Structure and Values
- The Human Genome, Cloning, and Bioethics
- Is Artificial Intelligence an Oxymoron?
- The Changing Face of Education
- The Evolution of Social Media
- Politics in the Age of the Internet
- The Web We Weave: Environmental Impact
- Capitalism, Social Justice, and the Globalization of Humankind
- Implications for Human Evolution?