



CoE 3002

Fall 2020 / Tu-Th 5:00-6:15pm

“Introduction to the Microelectronics and Nanotechnology Revolution”

John D. Cressler

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Course Description

“We are in the swirling center of the most life-changing technological revolution the Earth has ever known. In only 70+ years, an eye-blink of human history, a single technological invention has launched the proverbial thousand ships, producing the most sweeping and pervasive set of changes ever to wash over humankind; changes that are reshaping the very core of human existence, on a global scale, at a relentlessly accelerating pace. And we are just at the very beginning ...”

Welcome to the microelectronics and nanotechnology revolution! This course will develop the general scientific and engineering underpinnings of microelectronics and nanotechnology, and examine how this new technological revolution is influencing a broad array of interdisciplinary fields (engineering, biology, biomedical engineering, material science, chemistry, physics, medicine, technology, management) and civilization as a whole (art, business, film, entertainment, politics). Special “widget deconstruction” topics will address common pieces of modern technology (e.g., smart phone, flash drive, GPS, DVD, digital camera, etc.) from the perspective of: “How do they do what they do?”; “How does microelectronics & nanotechnology play in that functionality?”; and “Where is the technology going and how will it change the way we live our lives?” Student-led team debates and class discussion threads will examine the transformational impact of the microelectronics and nanotechnology revolution on modern society. A team “widget deconstruction” project will serve as a capstone for the course. No special knowledge of electrical and computer engineering is assumed. This class will be highly interactive and student participation is key.

About the Prof: Dr. Cressler was awarded the 2010 Class of 1940 W. Howard Ector Outstanding Teacher Award (Georgia Tech’s top teaching award), and the 2013 Class of 1934 Distinguished Professor Award (the highest honor Georgia Tech bestows on its faculty). Visit: <http://cressler.ece.gatech.edu/> and <http://johndcressler.com>.

Come Join the Fun!

Course Syllabus

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Georgia Institute of Technology

Chapter 1 The Communications Revolution

- 1.1 The Big Picture
- 1.2 Evolutionary Trends: Moore’s Law and Silicon ICs
- 1.3 The Micro/Nanoelectronics Distance, Time, Frequency, and Energy Scales
- 1.4 An Historical Perspective

Chapter 2 Widget Deconstruction #1: Smart Phone

- 2.1 With a Broad Brush
- 2.2 Nuts and Bolts
- 2.3 Where are the Integrated Circuits and What Do They Do?

Chapter 3 Semiconductors

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

Chapter 4 Widget Deconstruction #2: USB Flash Drive

- 4.1 With a Broad Brush
- 4.2 Nuts and Bolts
- 4.3 Where are the Integrated Circuits and What Do They Do?

Chapter 5 Micro/Nanoelectronics Fabrication

- 5.1 The In’s and Out’s of Micro/Nano Fabrication
- 5.2 Building Mr. Transistor and Packaging Him

Chapter 6 Transistors

- 6.1 Why Are Transistors So Darn Useful?
- 6.2 The pn Junction
- 6.3 The BJT
- 6.4 The MOSFET

Chapter 7 Widget Deconstruction #3: GPS

- 7.1 With a Broad Brush
- 7.2 Nuts and Bolts
- 7.3 Where are the Integrated Circuits and What Do They Do?

Chapter 8 The Nanoscale World

- 10.1 Nanotech, Nanobots, and Grey Goo
- 10.2 Darwinian Evolution in Microelectronics: The End of the Silicon Road
- 10.3 Buckyballs, Nanotubes, Graphene, and Nanoapps