



## CoE 3002

Fall 2026 on Tu/Th 5:00pm-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., smartwatch, GPS, HDTV, digital camera, Blu-Ray, 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?” 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.

# “Introduction to the Microelectronics and Nanotechnology Revolution”

CoE 3002  
Fall Semester 2026

School of Electrical and Computer Engineering  
Georgia Institute of Technology

**Dr. John D. Cressler**

## **When and Where:**

**Lecture Place:** Room 221, College of Business (Scheller)  
**Lecture Time:** Tu / Th 5:00-6:15 pm

## **My Contact Information:**

**email:** cressler@ece.gatech.edu

**office:** Room 521 in TSRB (in Tech Square—first building on the left as you cross the 5<sup>th</sup> Street Bridge – elevator to 5<sup>th</sup> floor, extreme SE corner of the building)

**phone:** (404) 894-5161 (office)  
(404) 351-0198 (home, emergencies only please)  
Note: I do not typically carry a smart phone (surprise!)

**My websites:** <https://cressler.ece.gatech.edu> (research)  
<http://johndcressler.com> (books)

## **My Office Hours:**

In general, right after class is ideal for lecture-related questions, since it is fresh on both our minds, so hang around and ask away! For F25, I will have formal office hours on **Tuesday at 11:30am-12:00pm and Monday at 4:30pm-5:00pm**. If you are coming, please drop me a note. Office hours will be very important for us, for several reasons. It is not only a time to answer questions you may have about the material, or to solve problems, or look at HWs, etc. It is also a time to check-in, actually see each other face-to-face outside of class, and help me get to know you better. Thus, I am requiring all students to attend at least a portion (can be as small as a few minutes to say “hi”) of at least one office-hour session per month (3 total – Sept/Oct/Nov). Totally fine to come in groups. Preferred, in fact. If you need additional time with me outside of office hours, to talk about class, life, how you are feeling, our troubled world, or anything else that may be on your mind, drop me a note and we can set that up. In short, I am here for you.

**In general, if you need me and cannot find me ... email me!**

# Course Policies and Procedures

## Prerequisites

Graduated High School (hopefully some Calculus, Chemistry, and Physics) + an Adventurous Spirit!

## Textbook

J.D. Cressler, Silicon Earth: Introduction to Microelectronics and Nanotechnology, 2<sup>nd</sup> Edition, CRC Press, 2016. You can get this in B&N@GT or from Amazon (eBook is fine). You will enjoy the book! Very different than what you are used to.

**IMPORTANT:** 1<sup>st</sup> Edition will not work!

## Course Materials

I am old school about some things, in that I hand out copies of all materials used the course (using only recycled paper, of course). This includes reading assignments, overheads, discussion topics, HWs, etc. Does it take a few trees to provide this? It does. That said, having a self-contained hard copy of all the class materials in a binder at your fingertips will aid your absorption of the material, and also serve to preserve it in its entirety for downstream use and reference. You need to get a binder (2-inch) to house your materials. They will be used in every lecture, so make sure you bring them to class. No need to bring the book to class.

As an aid to each of you, you can expect a Sunday afternoon email on what we will be doing for the coming week. Regular checking on your email (several times a day) will be very important for you to stay up to speed on things.

## About Me

If you would like to know more about who I actually am and what makes me tick, I would suggest a couple of possibilities:

- 1) List to my GT Commencement Address (topic is love)
- 2) Listen to my TED<sup>x</sup> talk (first TED<sup>x</sup> at GT)
- 3) Check out my philosophy on Teaching and Mentoring
- 4) Check out my personal “Credos”

All are buttons on the left side of my homepage, located at:

<https://cressler.ece.gatech.edu>

In addition, I am a writer and have published 9 books now (4 are novels). My 10<sup>th</sup> book (on science and spirituality) is almost done. If you are curious about my historical fiction, or my non-fiction, visit:

<https://johndcressler.com>

## Lectures

CoE 3002 is a face-to-face, fully residential class, requiring student attendance in person. No remote option is provided.

Lectures will consist of a mixture of on-the-board notes, overheads, class discussion threads on reading assignments, problem solving, project presentations, and (many) digressions on life. This is a highly participatory class. Do not anticipate being a spectator. **Attendance is mandatory and roll will be taken.**

If you do have to miss a lecture, for whatever reason, you are expected to let me know in advance via email. If you come in late after I have called roll (hint: not a grand idea!), you are responsible for making sure that I know you are present. All students are responsible for all material covered in class (written or orally transmitted), and which can appear on exams.

## Electronic Gadgets and AI

**All my classes are electronics-free. Period.** All e-Gadgets, of any make or model, must be powered off and stowed in your backpack during class: smart phones, laptops, iPads, etc. Texting of any kind (via phone or smartwatch) is not permitted. Electronics distract both you and me, and they get in the way of our learning and the classroom vibe I aim to instill. Yes, I am well aware of the rich irony presented by this mandate! Regarding AI. It has its place in research to be sure, but as we will explore together, its detrimental social and learning impact can bend potentially catastrophic without too much imagination. And in my view, AI is a terrible idea for the nature of this class. Please remember, you will not have it on exams, so please don't be lulled that using it for your HWs. Not a grand idea. And, by all means, do not ever use ChatGPT to draft emails to me!

## Homework

For full-credit, homework must be turned-in by the beginning of class on the assigned date. Joint work on homework is allowed (encouraged, in fact), but each student **MUST** hand-in their own individual solution. HW will consist of problems of varying difficulty and length. Good grammar and diction most definitely count.

## Exams

Exams will be closed book and closed notes. **Both** sides of a single 8.5 x 11.0-inch sheet may be brought in for formulas, notes, etc. This sheet will be turned in with the exam. Partial credit will be given, but only if you provide a clear, legible, and easy-to-follow exposition of your solution. **Box off your final answers.** Good grammar and diction count. A (simple) calculator will be needed for exams. A practice exam will be given to students.

## **GroupMe**

A voluntary class GroupMe is a great idea for answers/help, and community building. Somebody please volunteer to set that up. If you want me to join (by internet, not phone!), just invite me. If you need me to join and I'm not, just email me!

## **Grading Policy**

Course grades will be calculated according to the following formula, based on a 100-point scale:

- Homework - 25%
- Exam 1 - 20%
- Exam 2 - 30%
- Team Project - 25%

Optional extra credit opportunities will be offered during the semester.

## **Academic Honesty**

Students are expected to abide by Georgia Tech's established Academic Honor Code (refer to the General Catalog if you have questions—visit: <https://policylibrary.gatech.edu/student-life/academic-honor-code>)

While students are encouraged to work together on homework, individual solutions must be submitted for grading. No collaboration in any form is permitted on exams (no student-to-student or student-to-internet connections are allowed).

## **Students with Disabilities**

I am always happy to accommodate students with disabilities. Students should consult the Office of Disability Services and come chat with me about your specific needs. Please visit: <https://disabilityservices.gatech.edu/>

## **Student Well-Being**

Your well-being is a big deal to me, and for sure GT is a pressure cooker, so please don't take your mental, physical, and emotional health lightly. If you need to talk, I am here to listen. Always. If you need advice, ask. GT has a variety of available student well-being resources available. Please avail yourself of them. For example, visit: <https://mentalhealth.gatech.edu/>

### ***Georgia Tech Calendar***

<b><u>Event</u></b>	<b><u>Day</u></b>	<b><u>Date</u></b>
. Our First Class	Tuesday	8/25
. Fall Break	Tuesday	10/6
. Thanksgiving	Thursday	11/26
. Our Last Class	Tuesday	12/8

### ***CoE 3002 Calendar***

<b><u>Event</u></b>	<b><u>Day</u></b>	<b><u>Date</u></b>
. Exam 1	Thursday	9/24
. Exam 2	Tuesday	11/17
. Final Project	Thursday	12/10 (6:00-8:50pm!)

## **My Expectations of You**

Class participation matters a great deal to me. In fact, it will be used to determine borderline grading cases. Meaningful participation during lecture requires preparation for lecture on your part. Read the course material. Review your notes from the prior class before you come to lecture. I expect all students to be respectful of their fellow students (and me). I expect you to be alive and kicking during lecture, and responsive to my questions. Please be on time for lecture. We will start promptly at 5:00 pm. I will do my very best to end class promptly at 6:15. All electronic gadgets must be powered off and stowed during lecture! Smile and relax ... you are among friends!

## My Teaching Philosophy

I teach because I love interacting with bright and thoughtful young people who share my love of learning. As a consequence, simply stated, I am here for you. Period. I view the classroom as Sacred Space (capital letters quite intentional), and I take my teaching very seriously. I am concerned about any impediment to your learning and happiness, whatever that may be, and I will do whatever I can within my power to help you. In short, I care about you and your well-being.

My goal in this class is to help facilitate your mastery of this material, but also to convince you of the beauty and majesty of the subject matter, so you can better appreciate the profound transformative impact what we are learning has for the peoples of planet Earth. In short, I will invite you to see our amazing world through different eyes. And I aim to add some insight into the meaning of life as well!

It is my job to make the material clear to you. If I'm not succeeding in that, I am depending on you to make me aware of it. I conduct my classes informally. If you have a question, or comment, or need me to repeat something, or can't read my writing, or you don't follow what I'm saying - interrupt me (politely). There is no such thing as a dumb question. All questions are the potential source of deeper enlightenment for you and me and the rest of the class. Ask!

I would be most happy to discuss any aspect of life with you, including: your experiences at Georgia Tech, your career path, attending graduate school, the meaning of life—you name it, I'm game! As you will see, I am fond of quotations, and offer them to you for your deeper reflection. They are also intended to remind you that there is much more to life than Georgia Tech!

# **Course Material by Chapter**

## **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 A 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: 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 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

# **Let the Games Begin!**