

**Course Number & Name:** EEE 4329 / 5400 - Future of microelectronics circuits

**(Spring 2021 CLASS on EDGE Lectures on E-Learning)**

**Credits and Contact Hours:** 3 crs; 3 classes per week of 50 minutes each

**Instructor's or Course Coordinator's Name:** Dr. Scott E. Thompson

Instructor Prof. Scott Thompson  
535 Engineering Bldg  
846-0320  
Office hours: MWF 7<sup>th</sup> period  
Plus e-learning discussion board (<https://lss.at.ufl.edu/>)  
(Plus welcome additional office hours arranged email [thompson@ece.ufl.edu](mailto:thompson@ece.ufl.edu))  
(Please stop by to talk about class or career or any topic of interest)

**Textbook Title, Author, and Year:** Nanoelectronics and Information Technology 2003 or equivalent. **Textbook OPTIONAL**

**a. Supplemental Material:** ~35 journal papers and handouts

### **Specific Course Information**

**a. Catalog Description:** Analysis and design of possible future transistor technology to fabricate microelectronics circuits

**b. Prerequisites or Co-requisites:** Electronics I, Solid State Devices, Basic knowledge of semiconductor physics and devices. The class will be introductory and targeted towards students with a diverse background from electronics to material science. The class will be designed to introduce CMOS, non classical CMOS, and post CMOS device concepts without a quantum mechanical background.

**c. Required, Elective, or Selected Elective (Table 5-1):**

### **Specific Goals for the Course**

**a. Specific Outcomes of Instruction:**

This course focuses on analysis and design transistors for the fabrication of future microelectronic circuits and memory. A very brief introduced and described CMOS digital and memory technology will be introduced along with Moore's law and scaling trends. Next class will most of the time on analysis of potential technologies to replace Si CMOS transistors.

**b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by this course:**

EE2, a, c, e, I, k

## Brief List of Topics to Be Covered

### Week 1: Anatomy of a Modern Computer

- History of Computing / Anatomy of an Ipad
- Moore's Law and microelectronic industry trends
- Chip technology / nonmanufacturing in Ipad (Logic chips, RF analog, DRAM, NAND, CMOS image sensor, motion sensors, 3D camera)

### Week 2: State of the art: logic technology

- 20nm /16m, 14nm, 10nm, planar and FinFET.
- Design rules/ double and triple patterning /SRAM layout

### Week 3: Moore's Law and Nanotechnology

### Week 4 Start of the art DRAM

### Week 5 State of the NAND FLASH

### Week 6 CMOS Image Sensors and 3D cameras

### Week 7 Carbon nanotube Transistors

### Week 8 Advanced Device Concepts / Nanofabrication limits

- Lithography
  - 193i, EUV
- Devices limits: mobility, velocity saturation, quantum-statistical

### Week 9. Resistive RAM, PCRAM and Cross point 3D memory

### Week 10: MRAM and Universal Memory

### Week 11 DRAM and Moore's Law Revisited

- Post conventional CMOS, DRAM and NAND technologies
- Gate all around CMOS, III-V material, 3D,
- Carbon nanotubes transistors
- Single electron devices for Logic applications
- Other??

### Week 12 Next wave of computing (internet of things / wearable electronics)

- Near threshold computing?

### Week 13 Single Electron Devices

### Week 14-15 Spintronic and Quantum Computing

### Week 16: Future Careers / Final Project

### • Grading:

– 80%

- 15% Exam 1 Wednesday Feb 10
- 20% Midterm Part 1 Friday March 26
- 20% Midterm Part 2 Friday April 16
  
- 25% Comprehensive final exam as scheduled by college
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- No exam make-up unless valid excuse. All valid excuses must be approved by the Professor.
- 5% Homework
- 15% Final Class Project
- Final Grading Scale
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- $\geq 90\% \rightarrow A$ ;  $\geq 86.67\% \rightarrow A-$ ;  $\geq 83.33\% \rightarrow B+$ ;  $\geq 80\% \rightarrow B$ ;  $\geq 76.67\% \rightarrow B-$ ;  $\geq 73.33\% \rightarrow C+$ ;  $\geq 70\% \rightarrow C$ ;  $\geq 66.67\% \rightarrow C-$ ;  $\geq 63.33\% \rightarrow D+$ ;  $\geq 60\% \rightarrow D$ ;  $\geq 56.67\% \rightarrow D-$ ;  $< 56.67\% \rightarrow E$
- Attendance: Due to quantity and research nature of material, it is important to make every attempt to attend class or watch all class lectures. Class attendance is required on days I announce class discussions.