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 7th period
Plus e-learning discussion board (https://lss.at.ufl.edu/)
(Plus welcome additional office hours arranged email 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 Logic Technology Roadmap
  • Past: BJT, planar NMOS, planar CMOS, FinFET
  • Technology nodes 22nm to 1nm
  • Overview Planar, FinFET, GAA, CFET
  • Overview Standard cells and logic density
Week 2: Nanowires , Nanosheets and CFET
Week 3: Burried power rails
Week 4 Start of the art DRAM
Week 5 State of the NAND FLASH
Week 6a Introduction to SEMulator3D software
Week 6b 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 (in person exam for hybrid section of class)
    • 25% Comprehensive final exam as scheduled by college
  – No exam make-up unless valid excuse. All valid excuses must be approved by the Professor.
– 5% Homework
– 15% Class project: SEMulator3D software

– Final Grading Scale

• ≥90% → A;  ≥86.67% → A-;  ≥83.33% → B+;  ≥80% → B;  ≥76.67% → B-;
  ≥73.33% → C+;  ≥70% → C;  ≥66.67% → C-;  ≥63.33% → D+;  ≥60% → D;
  ≥56.67% → D-;  <56.67% → 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.