Course Number & Name: EEE 4310 and EEE5322 - Digital Integrated Circuits Design

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

Contact info
Prof. Scott Thompson
535 Engineering Bldg
846-0320
Office hours: M W F 6th period days of live class
Plus e-learning discussion board (https://lss.at.ufl.edu/)
(plus additional office hours arranged via email thompson@ece.ufl.edu)

Teaching assisstants
TA Yingjie Chen (chenyingjie@ufl.edu)
TA Xiaodong Xu (xu1992@ufl.edu)
TA Office hours: (email to arrange)

Textbook Title, Author, and Year:

Title - Introduction to Microelectronic Fabrication (Required)
Author - Richard C. Jaeger
dISBN Number - 0-201-44494-7

Title - Digital Integrated Circuits, A Design Perspective (Required)
Author - Jan. M. Rabaey, A. Chandrakasan, and B.Nikolic

Computer and Software required: Workstations with CADENCE Design system on campus, off-campus can use XWindows or X-terminal on a high-speed internet link to UF Campus Computers, or can use equivalent IC design software

Specific Course Information
a. **Catalog Description:** Fabrication, Layout, Analysis and design of digital and circuits using MOS Transistors

b. **Prerequisites or Co-requisites:** EEL 3396, EEL 3308
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 of modern digital circuits. Silicon technology and transistors are introduced and described from a digital point of view, and the performance of various circuits is derived and estimated. CMOS digital circuits will be designed and analyzed. Students will have a semester long team SRAM chip design project using commercial software Cadance. Project will cover advanced topics such as manufacturing variations.

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

### Topics to Be Coverer

**Week 1:** Moore’s Law, History and Future of Computing, Chipworks tear down of a mobile computer (iPhone and iPad), Jaeger Chapter 1.

**Week 2:** Design rules, Chap. 2.1, 2.2 and 2.3 of Rabaey, 1.2, 1.3.1

**Week 3:** Contacts and Interconnects Chap. 7 Jaeger and handouts. MOS Process Integration Chap. 9 of Jaeger and State of the art CMOS planar and FinFET SOC process flow: 28nm, 20nm, 14nm, 10nm Logic Technologies and advanced layout issues: Optical Proximity correction and Restrictive Design Rules

**Week 4-5:** What is VLSI, **Cadence Design Training**, Statistics Review, and Introduction to micro fabrication with emphasis on process variation Chap. 5.1, 5.2, 5.3, 5.4 of Jaeger, plus handouts and Chipworks reverse engineering reports

**Week 6-7:** CMOS Logic, DRAM, NAND, CMOS image sensor chips fabrication, bit cell or pixel cell, and array architecture Chap. 8.7 of Jaeger and Chapter 2.2 Rabaey plus handouts

**Week 8-9:** Layout Layers and X-sections Design Rules, Resistance, Capacitance, MOSFET Chap. 4.1 to 4.3 and Chap. 3.3 of Rabaey and 9.2, 9.3 Jaeger

**Week 10:** MOS Transistors, CMOS Inverters, Chap. 3.3 and Chap. 5 of Rabaey

**Week 11:** CMOS Inverters, Chap. 5 of Rabaey

**Week 12:** Combination Logic, Compound Gates, Chap. 6 of Rabaey
Week 13: Transmission Gates, Memory, Chap. 6 and Chap. 12 of Rabaey

Week 14: Memory, Pseudo NMOS, Pass Trans. Logic, Chap. 6 of Rabaey

Week 14: Pre-charge Logic, and Dynamic Logic, Chap. 6 of Rabaey

Week 15: Domino Logic, Logic Comparison, Noise Chap. 6 of Rabaey

- Grading:

  Class exams
  
  100 Points  Test 1  Friday Sept. 20
  100 Points  Test 2  Wednesday Oct. 23
  150 Points  Test 3  Monday Nov. 18
  250 Points  Comprehensive Final as scheduled by college (12:30-2:30 Thursday Dec. 11)

  Cadences assignment 1 (25 points)
  Group SRAM Design project  (150 points)  Final Class Project Due Dec 4 (midnight)

  Homework 10 points per assignment

- Test and projects and homework different for EEL 4310 and EEL5322

- No exam make-up unless valid excuse. All valid excuses must be approved by the Professor

  - Final Grading Scale

  • $\geq 90\% \rightarrow A; \geq 86.67\% \rightarrow A-; \geq 83.33\% \rightarrow B+; \geq 80\% \rightarrow B; \geq 76.67\% \rightarrow B-$
  $\geq 73.33\% \rightarrow C+; \geq 70\% \rightarrow C; \geq 66.67\% \rightarrow C-; \geq 63.33\% \rightarrow D+; \geq 60\% \rightarrow D$
  $\geq 56.67\% \rightarrow D-; < 56.67\% \rightarrow E$

- Attendance: Due to quantity and research nature of material, it is important to make every attempt to attend class or watch all class lectures (when possible).