ELEC 5190/6190/6196 - Introduction to Digital and Analog IC Design

To be offered in Fall 2009

2009 Catalog Data ELEC 5190/6190/6196. INTRODUCTION TO DIGITAL AND ANALOG IC DESIGN (3). LEC. Pr. ELEC 2210, ELEC 3700. Introduction to digital and analog integrated circuit (IC) design with emphasis on front-end IC design skills. Digital IC designs using Verilog hardware description language. Analog IC designs using Cadence analog IC design tools. Gain hands-on experience through digital and analog IC design projects.

Textbook: None
Course information located on AU Blackboard: https://blackboard.auburn.edu

References:

- *Microelectronic Circuit Design* by R. C. Jaeger and T. N. Blalock, 2004.
- *RF Microelectronics* by Behzad Razavi
- *The Verilog Hardware Description Language* by Philip R. Moorby, Donald E. Thomas.
- *Integrated Circuit Design for High-Speed Frequency Synthesis* by J. Rogers, C. Plett, and F. Dai
- Course info located at AU Blackboard site: https://blackboard.auburn.edu

Coordinator: Fa Foster Dai, Professor of Electrical and Computer Engineering

Objectives: High performance digital and analog integrated circuit (IC) design is a key to the success of high data rate broadband networks. This course provides information about fundamentals of wireless communication systems and transceiver circuit designs. It introduces both digital and analog IC designs with emphasis on the front-end IC design skills. Students will learn Verilog Hardware Description Language for digital ASIC designs and will gain hands-on experience in analog IC designs using Cadence Analog IC Design Tools. The course is designed for senior and graduate levels with prerequisite of ELEC 2200 Digital Logics, ELEC 2210 Digital Electronics and ELEC 3700 Analog Electronics or with consent of the instructor. Grading for 6190 requires additional work on class projects and exam questions.

Topics: (75 minute classes, twice per week)

- Introduction to Wireless Communications (1 class)
- Review of Bipolar and MOS Transistors in Integrated Circuits (2 classes)
- Digital IC Design Using Verilog HDL (5 classes)
- Digital Frequency Dividers (2 classes)
- Digital Delta-sigma Modulators (3 classes)
- Direct Digital Synthesizers (2 classes)
- Midterm Exam (1 class)
- Analog IC Design Using Cadence Analog IC Design Tools (5 classes)
- Switching and Logic Circuits (2 classes)
- Current Mirrors (2 classes)
- Linear Circuits and Amplifiers (3 classes)
- Final Project Presentations (2 classes)
- Final Exam

Grading: Different requirements applied to 5190 and 6190/6196. Students enrolled in ELEC 6196 for distance learning can remotely access the IC design tools through College of Engineering's VPN network. ELEC 6196 students can give their final project presentations by submitting a presentation ppt file and a presentation audio file for grading purpose.

- Project I (10%), Digital Design Using Verilog HDL. Project topic may vary.
  5190: Design of a divide by 2/3 dual modulus prescaler;
  6190: Design of a 3-bit multi-modulus divider using cascaded 2/3 cells.
- Project II (10%), Digital Design Using Verilog HDL. Project topic may vary.
  5190: Design of a 1st order modulator;
  6190: Design of a 3rd order modulator.
- Midterm Exam (20%) ***(****Additional questions applied to 6190)*
- Project III (10%), Analog IC Design in Cadence Design Environment. Project topic may vary.
  5190: Design of a divide by 2/3 dual modulus prescaler using CML logic;
  6190: Design of a 3-bit multi-modulus divider using cascaded 2/3 cells using CML logic.
- Final Project Report & Presentation (20%), Selected Digital or Analog Designs for Wireless Transceivers.
- Final Exam (30%) ***(****Additional questions applied to 6190)*

Primary program outcomes related to this course:

Outcome 1. Ability to apply knowledge of math, science and engineering to solve problems.
Outcome 2. Ability to apply in-depth knowledge in one or more disciplines.
Outcome 3. Ability to design an electrical component or system to meet desired needs.
Outcome 6. Proficiency in the use of computers and other modern tools to solve engineering problems.
Outcome 8. Proficiency in communicating ideas and information orally and in writing.
Outcome 9. Appreciation of the need for, and an ability to learn new concepts as required for the continuing practice of ECE.

Computer usage: Verilog simulator and Cadence® Analog Artitist.

Attendance Policy: Course attendance is strongly encouraged, but will not be a factor in determining the course grade.

Justification for Graduate Credit: Students enrolled in ELEC 6190/6196 will be assigned more advanced projects than the students in ELEC 5190, as indicated under Grading above. This will require additional reading from the current literature on IC design. Additional exam questions will test comprehension of this material.

Special accommodations: Students who need accommodations are asked to arrange a meeting during office hours the first week of classes, or as soon as possible if accommodations are needed immediately. If you have a conflict with my office hours, an alternate time can be arranged. To set up this meeting, please contact me by E-mail. Bring a copy of your Accommodation Memo and an Instructor Verification Form to the meeting. If you do not have an Accommodation Memo but need accommodations, make an appointment with The Program for Students with Disabilities, 1244 Haley Center, 844-2096 (V/TT).

Academic Honesty Policy: All portions of the Auburn University student academic honesty code (Title XII) found in the Tiger Cub will apply to this class. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Prepared by: Fa Foster Dai, Date: Jan. 4, 2008.