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

2008 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 IC design with emphasis on front-end IC design skills. Digital IC design using the Verilog hardware description language. Analog and mixed signal IC design using industry-standard analog IC design tools. Digital and analog IC design projects.

Textbook: None

Course information located at AU WebCT:

References:
The Verilog Hardware Description Language by Philip R. Moorby, Donald E. Thomas.
RF Microelectronics by Behzad Razavi
Radio Frequency Integrated Circuit Design by John Rogers and Calvin Plett

Coordinator: Foster Dai, Professor of Electrical and Computer Engineering

Objectives: Wireless and wire-line communications remain as a star players fueled by the emerging of wireless local area networks (WLAN), the 3rd generation W-CDMA technology and 40Gb/s fiber networks. High performance digital and analog signal IC design is a key to the success of high data rate broadband networks. This course provides information about fundamentals of wireless and fiber communication systems and the transceiver circuit designs. It introduces both digital and analog IC designs with emphasis on the front-end IC design skills. You will learn Verilog Hardware Description Language for digital ASIC designs. You will gain hands-on experience in analog and mixed signal IC designs using industry popular Cadence CAD 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 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 and Wire-line Communications (1 class)
- Review of Bipolar and MOS Transistors in Integrated Circuits (1 class)
- Digital IC Design Using Verilog HDL (5 classes)
- Digital Frequency Dividers (2 classes)
- Digital Filters and Interpolators (3 classes)
- Direct Digital Synthesizers (DDS) (2 classes)
- Analog IC Design Using Cadence Analog IC Design Tools (6 classes)
- Switching and Logic Circuits (2 classes)
- Current Mirrors (2 classes)
- Linear Circuits and Amplifiers (3 classes)
- Midterm Exam (1 class)
- Project Presentations (2 classes)

Grading: (Different requirements applied to 5190 and 6190/6196)
- Project I (10%), Digital Design Using Verilog HDL.
  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.
  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 Analog Design Environment.
  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.
• Project IV & Presentation (20%), Selected Digital or Analog Designs for Wireless or Wire-line 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.

**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.

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