ELEC 7190/7196 - Advanced RFIC Design for Wireless Communications

Catalog Data: ELEC 7190/7196. ADVANCED RFIC DESIGN FOR WIRELESS COMMUNICATIONS (3) LEC. (3). Pr. ELEC 5190 or ELEC 6190. Wireless standards and multi-standard transceiver architectures, SiGe and CMOS RFIC designs for wireless transceiver building blocks, software defined radios, phase array radars, ultra-high speed data converters, and MIMO wireless transceivers.

Textbook: none

Reference Books:
- RF and Microwave Circuit Design for Wireless Communications by Lawrence E. Larson
- Radio Frequency Integrated Circuit Design by John Rogers and Calvin Plett
- Integrated Circuit Design for High-Speed Frequency Synthesis by J. Rogers, C. Plett, and F. Dai
- Course info located at AU WebCT site: https://webct.auburn.edu:444/webct/public/home.pl?action=print_home

Coordinator: Foster Dai, Professor, Electrical and Computer Engineering

Objectives: The boom of wireless and mobile networks leads to an ever-increasing request for high performance, low power, and low cost radio frequency integrated circuit (RFIC) designs. The advance in silicon and silicon-germanium based technologies has led to highly integrated systems on a chip. RFIC designs for wireless networks provide plenty of design challenges with both academic and commercial values. This course starts with a discussion on various mobile wireless standards and transceiver architectures for multi-standard coexistence (CDMA, GSM, WLAN, WiFi, WiMAX, UWB, GPS, DVB, etc). It then focuses on advanced RFIC designs for wireless transceiver building blocks such as LNA, mixer, VGA, VCO, frequency synthesizer, programmable filters, and so on. This course reflects the most recent research achievements in RFIC designs and presents advanced topics on next generation radio platforms including software defined radios, phase array radars, ultra-high speed data converters, and MIMO wireless transceivers.

Prerequisite: ELEC 5190/6190 Introduction to Digital and Analog IC Design, or consent of the instructor.

Topics: (Classes assumed to be 75 minutes, twice per week)
- Wireless standards and multi-standard transceiver architectures (2 classes)
- Wireless modulation/demodulation and multiple access techniques (2 classes)
- RFIC design fundamentals (4 classes)
- Front-end designs (low noise amplifier and mixer) (4 classes)
- Frequency synthesizer designs (PLL, DDS, phase detector, charge pump, voltage controlled oscillator and multi-modulus divider) (4 classes)
- Integrated filters designs (2 classes)
- Variable gain amplifier designs (2 classes)
- MIMO wireless transceivers (2 classes)
- Software defined radios (2 classes)
- Phase array radars (2 classes)
• Ultra-high speed data converters (2 classes)
• Project presentations (2 classes)

Grading:
• Project I (10%), Design of Bandgap Reference.
• Project II (10%), Design of 5GHz LNA.
• Project III (10%), Design of Double-Balanced Mixer.
• Project IV (10%), Design of 5GHz VCO.
• Final Project & Presentation (30%), Selected Building Block Designs For Wireless Transceivers
• Final Exam (30%)

Computer usage: Verilog simulator and Cadence® Analog Artitist.

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
This course covers advanced radio-frequency integrated circuit (RFIC) design and related topics that are beyond the scope of undergraduate electronics courses.

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