## Winter 2015 Special Topics

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<td>72006</td>
<td>EEC 289K - Integrated Circuits for Wireless Communications</td>
<td>3</td>
<td>Jane Gu</td>
<td>MW 4:40 - 6:00 p.m.</td>
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<tr>
<td>93893</td>
<td>EEC 289O - Integrated Circuit Design for Phone Electronics</td>
<td>3</td>
<td>Rajeevan Amirtharajah</td>
<td>MW 3:00 - 4:30 p.m.</td>
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EEE 289K- Integrated Circuits for Wireless Communications

3 units – Winter 2015

Prerequisite: EEC 132A and EEC 112 or equivalent

Grading: Letter

Time and location: MW 04:40 PM-06:00 PM Wellman Hall 00123

Evaluation: The final grade will be based on homework assignments (10%), a mid-term exam (30%), final exam (40%), and design project (20%).

Tentative Course Description

Part 1 (about 1~2 weeks): Analyze key circuit and system specifications, such as noise figure, linearity etc. This part will cover the key design specification definition and analysis and use real circuit examples to analyze these key specs and link to the design parameters, such as circuit structure, device size, and bias condition. Both CMOS and bipolar devices will be used for comparison.

Part 2 (about 1 week): Review and wrap up of different transceiver architectures: heterodyne, homodyne, digital-IF. This part will review the major differences and system specification concerns for different transceiver architectures and use existing circuit and system examples for practical analysis.

Part 3 (about 2~3 weeks): Analyze and design amplifiers. This part will majorly cover LNA design, including the detail analysis of each LNA structure, such as common source, common gate, and source follower in transistor level. It will also use both bipolar and CMOS to demonstrate the design difference. Impedance matching network will also be covered.
Part 4 (about 2 weeks): Analyze and design frequency conversion circuits, majorly focusing on down conversion and up conversion mixers. This part will cover the design details of mixers and analyze mixer performance with frequency conversion scenarios, as well as practical design considerations.

Part 5 (about 3 weeks): Analyze and design synthesizer circuits. This part will cover the analysis of different synthesizer architectures, design of individual components in synthesizers, including VCO, divider, charge pump, PFD etc.

A design project on CMOS in this course will be included

Textbooks:
“RF Microelectronics” Behzad Razavi
“The Design of CMOS Radio-Frequency Integrated Circuits” Thomas Lee

Instructor: Jane Gu
EEC 289O - Integrated Circuit Design for Power Electronics

Lecture: MW 3-4:30
Wellman 123

Instructor: Rajeevan Amirtharajah
Associate Professor
3173 Kemper Hall
(530) 341-2522
ramirtha@ece.ucdavis.edu

Web Page: Access course webpage through UC Davis SmartSite.

Office Hours: TBD

Prerequisites: EEC 210

Grading: Letter (A: 100-90%, B: 90-80%, C: 80-70%, D: 70-60%, F: below 60%)
Midterm 25%
Homework 10%
Design Project #1 15%
Design Project #2 20%
Final Exam 30%

There will be a few homework assignments, two design projects, one midterm exam, and one final exam. The midterm exam will be held in class on a date to be determined. The final exam will occur during the final exam period. Homework problems will be graded on an effort scale: 0 points for poor effort, 1 point for nearly correct/reasonable effort, and 2 points for a correct answer.

Collaboration: You may discuss issues with other students on design projects, but you must design your own circuit and circuit test bench and perform your own simulations. Each student must turn in their own circuit design and project writeup. If you choose to discuss the project with other students, each student must list all of his/her colleagues who participated in any discussion(s) on the first page of their homework. Final projects will be done individually or in groups of at most two.

Late Design Projects: Design projects are due at the beginning of lecture. Twenty-five percent of the total points are deducted for each day the homework is late, until the assignment is worth 0 points four days after the official due date.

Curves: No curves on design projects. Exams will be graded on a curve if the class performance warrants it, and the curve will only improve your grade.

Extra Credit: No individual extra credit. Instructor might offer an extra credit assignment to the entire class, but only if absolutely necessary.
Course Description: IC design for power electronics. Linear and switching regulation. Integrated power management. DC/DC and AC/DC conversion. Applications in portable electronics and wireless sensors.

Course Outline:

I. Overview of Power Electronics
   A. Linear Regulation
   B. Switching Regulation
   C. Analysis Methods

II. Linear Regulators
   A. Simple Diode Regulator
   B. Low Dropout Regulator
   C. Shunt Regulator
   D. Series-Shunt Regulators

III. Switched-Capacitor DC/DC Converters
   A. Series-Parallel Architectures
   B. Charge Pumps
   C. Switched Capacitor Converter Optimization
   D. Application: Integrated Dynamic Voltage Scaling

IV. Inductor-Based DC/DC Switching Converters
   A. Buck Converter
   B. Boost Converter
   C. Buck-Boost Converter
   D. Switching Converter Optimization
   E. Analog and Digital Feedback Control
   F. Application: Photovoltaic and Thermoelectric Energy Harvesting

V. AC/DC Conversion
   A. Rectifiers
   B. Flyback Converters
   C. Application: RF Energy Harvesting

Reading:
1. Most material will be from classic and recent research papers on power electronics design.

Reference Material:
