ENG EC580 Modern Active Circuit Design

2007-2008 Catalog Data:
Prereq: ENG EC 412 and ENG EC 571 or consent of instructor. This course will teach the fundamentals of CMOS and BICMOS analog circuit design techniques used in today's advanced mixed-signal integrated-circuit applications. Topics to be covered include device/process background, IC passives, analog amplifiers, current mirrors, op-amp design, noise in ICs, RF design techniques, switched capacitor circuits, A/D and D/A converters, and mixed-signal circuitry typical of modern telecommunications technology. The course will include a laboratory component involving hands-on measurements with high frequency instruments in the RF Lab in PHO418 as well as the design, layout, and simulation of RF/analog integrated circuits using *Cadence SpectreRF* CAD tools in the VLSI Lab in PHO305. 4 cr.

Status in the Curriculum: Elective

Class/Lab Schedule:
Lecture: 4 hours/week. Laboratory: 2 hours/week

Textbooks and other required materials:
T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge, 2004 2nd edition.; Johns and Martin, Analog Integrated Circuit Design, Wiley, 1997.

Reference:
Gray, Hurst, Lewis, and Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 2001.
Coleman, Introduction to Radio Frequency Engineering, Cambridge, 2004.

Coordinator:
Ronald W. Knepper, Professor, ECE department

Prerequisites by topic:
EC412, EC571

Goals:
To provide the students with:
* An understanding of analog circuit design techniques
* Knowledge of typical analog circuits utilized in modern mixed-signal IC designs
* Proficiency in the use of industry-standard IC computer-aided design tools
* Experience in the design, simulation, and layout of real-world analog integrated circuits
* Experience in the use of state-of-the-art laboratory instruments for high frequency measurements

Course Outcomes:
As an outcome of completing this course, students should be able to:

1) possess a basic knowledge of analog circuitry used in mixed-signal integrated circuit applications
2) understand the concepts of high frequency transmission lines, matching, and S-parameters
3) understand the methodology of operational amplifier design using compensation for stability
4) understand the basic concepts used in high frequency amplifier design
5) understand the operation of comparators, switched capacitor circuits, A/D and D/A converters
6) design and simulate basic analog circuits at the schematic level, using Cadence Spectre/RF CAD tools
7) design basic analog circuits at the chip level including layout and simulation with extracted models
8) demonstrate proficiency in the use of the IBM 0.18um 7WL CAD design tool for analog/mixed-signal IC design and simulation
9) demonstrate proficiency in the use of Smith Charts and S-parameters for characterizing transmission line behavior using an RF network analyzer
10) possess the ability to read and understand current analog/mixed-signal publications in the IEEE JSSC

Course Outcomes mapped to Program Outcomes:

Program Outcomes:	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Course Outcomes:	1-5	6-9	6-7	9	1-10	1,10	10	1-5,10	8-10	1-10	6-9
Emphasis:	5	5	4	3	5	3	5	3	4	5	5

1=not at all; 5=a great deal;

Topics in Project Assignments:
Lab 1: Determine device characteristics of NMOS, PMOS, NPN Tx's using Cadence simulation
Lab 2: Design a current mirror-based opamp in CMOS or BiCMOS
Lab 3: Use of Agilent Network Analyzer to characterize cables, connectors, and MMIC amplifier
Lab 4: Design and characterize a high frequency amplifier at 1.8 GHz
Reading: Read and write a report on recent analog paper from IEEE Journal Solid-State Circuits
Final Project: Design a charge-redistribution 5-bit A/D converter

Contribution of Course to Meeting the Professional Component:
Engineering topics: 100%

Prepared by: Ronald W. Knepper Date: June 2009