16:332:599-Advanced Topics in Electronics:
RF Integrated Circuit Design
(Cross-listed with Topics in ECE: 14: 332:445)

Course Catalog Description:
16:332:599-Advanced Topics in Electronics: RF Integrated Circuit Design (3)
14:332:445: Topics in ECE: RF Integrated Circuit Design (3) `index 18466`
Basic concepts in RF design, analysis and design of RF circuits used in modern wireless systems

Pre-Requisite Courses:
14:332:463 (Analog Electronics)

Pre-Requisite by Topic:
Semiconductor devices, Transistor's frequency response, Analog Circuits, Electromagnetics

Textbook & Materials:
-RF Microelectronics, 2nd Edition, by Behzad Razavi, Prentice Hall, ISBN: 978-0137134731

References:
- The Design of CMOS Radio-Frequency Integrated Circuits, by Thomas H. Lee, ISBN: 978-0521835398

Overall Educational Objective:
The objective of this course is to present the concepts of design and analysis of modern RF and wireless communication integrated circuits. Topics covered are: basic concepts in RF design, scattering parameters, modern integrated circuit technologies, fundamental limitations of speed of operation of transistors, physics of noise, impedance matching, low-noise amplifiers, mixers, oscillators, phase noise, and phase locked loops.

Course Learning Outcomes:
It is expected that the students be able to apply the concepts and design techniques presented in this course to a wide range of applications including high-speed wireless communications and biomedical electronics.

How Course Outcomes are assessed:

Homework	15%
Mid-Term Exam	20%
Design Project	30%
Final exam	35%

Outcome		**Proficiency Level assessed by**
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Exams, Project
(b) an ability to design and conduct experiments and interpret data	N	
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	S	Project

(d) an ability to function as part of a multi-disciplinary team	N	
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Exams. Project
(f) an understanding of professional and ethical responsibility	N	
(g) an ability to communicate in written and oral form	S	HW Problems, Exams, Project
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	N	
(i) a recognition of the need for, and an ability to engage in life-long learning	S	HW Problems, Project
(j) a knowledge of contemporary issues	N	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW Problems, Exams, Project
Basic disciplines in Electrical Engineering	H	HW Problems, Exams, Project
Depth in Electrical Engineering	H	HW Problems, Exams, Project
Basic disciplines in Computer Engineering	N	
Depth in Computer Engineering	N	
Laboratory equipment and software tools	H	HW Problems, Project
Variety of instruction formats	S	Lecture, office hour discussions

Tentative Topics Covered week by week:

Week 1: Basic Concepts in RF Design
Week 2: Scattering Parameters
Week 3: modern IC technologies (SiGe, CMOS), fundamental limitation of speed of transistors
Week 4: Physics of Noise
Week 5: Transceiver Architectures: Heterodyne/Direct Conversion Receivers
Week 6: Transceiver Architectures: Low-IF Receivers, Heterodyne Transmitters
Week 7: Impedance Matching, RF Filters
Week 8: Low Noise Amplifiers
Week 9: Passive Mixers
Week 10: Active Mixers
Week 11: RF Passive Components
Week 12: Oscillators: Basic Principles, Cross-Coupled, VCO
Week 13: Phase Noise
Week 14: Silicon-based receivers, Layout consideration, Packaging Issues
Week 15: PLL

Computer Usage:
Design and Simulations using Cadence Spectre Circuit Simulator

Design Experiences:
Course design project

Independent Learning Experiences:
1. Homework, 2. Design Project

Contribution to the Professional Component:
(a) College-level Mathematics and Basic Sciences: 0.25 credit hours
(b) Engineering Topics (Science and/or Design): 2.75 credit hours
(c) General Education: 0.0 credit hours
Total credits: 3