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:

References:

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:
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Proficiency Level assessed by</th>
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<tbody>
<tr>
<td>(a) an ability to apply knowledge of Mathematics, science, and engineering</td>
<td>HW Problems, Exams, Project</td>
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<tr>
<td>(b) an ability to design and conduct experiments and interpret data</td>
<td>N</td>
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<tr>
<td>(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</td>
<td>Project</td>
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(d) an ability to function as part of a multi-disciplinary team  
(e) an ability to identify, formulate, and solve ECE problems  
(f) an understanding of professional and ethical responsibility  
(g) an ability to communicate in written and oral form  
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context  
(i) a recognition of the need for, and an ability to engage in life-long learning  
(j) a knowledge of contemporary issues  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice

| 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