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

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<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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<td>(b) an ability to design and conduct experiments and interpret data</td>
<td>N</td>
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<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>S Project</td>
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### 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