

# CND 311: RF Circuit Design

## Course Description

The main objective of this course is to cover the design of radio-frequency integrated circuits used for wireless communications from the theoretical and practical aspects down to the transistor level. The course starts with an introduction to wireless transceivers, LNA, different types of mixers, and time domain and RF network measurements. The students will get “hands-on” RFIC simulation/layout experience using modern industrial CAD tools.

## Prerequisites

Introduction to Analog Electronics

## Learning Outcomes

After successful completion of this course, the student will be able to:

1. Define the wireless system design aspects and RF system specifications.
2. Design and simulate Low noise and power amplifiers.
3. Understand the relationship and limitations of circuit topology and device characteristics to achieve competitive specifications.
4. Use modern advanced CAD tools to design, simulate, and create layout of RFIC.

## Course Materials

Textbook:

- Behzad Razavi, RF Microelectronics, 2nd Edition, Pearson
- Thomas H. Lee, The design of CMOS radio-frequency integrated circuits, 2nd Edition. Cambridge: Cambridge University Press.
- Tony Chan Carusone, David Johns, Kenneth Martin, analog Integrated Circuits, 5th Edition, Wiley.

References:

- Material derived from the IEEE Journal, Transactions, and the International Solid-state Circuits Conference (ISSCC) proceedings.

## Course Topics and Schedule

- Introduction to Wireless Systems
  - History of wireless technologies, wireless system design, and RF system specifications
  - Concepts about transceivers will be detailed, such as path loss, interference signals, receiver sensitivity, and transmitter output power.
- Amplifiers
  - Basic concepts of amplifiers, types of power gain, and most used amplifier topologies
  - Low noise amplifier matching and power amplifier classes.
- Mixers
  - Working principle of RF mixers and their basic concepts.
  - Active and passive mixers
  - Balanced and unbalanced mixers
  - Mixer's noise performance
  - Up and down-conversion mixers
- Introduction to Design Labs
- Introduction to Time Domain Measurements
- Introduction to RF Network Measurements and de-embedding techniques