

# ECE6420 - Wireless IC Design

**3 units**

**Prerequisite:** ECE 4430

## Course Description

- I. Basic concept of RF design for wireless communications**
  - A. Device nonlinearity and their effects in RF systems, gain compression, intermodulation, desensitization etc.
  - B. Device noise types, models, analysis and NF
  - C. System sensitivity and dynamic range
- II. RF Transceiver Architecture Analysis and Design**
  - A. Review of heterodyne and homodyne architecture
  - B. Image rejection receiver, Hartley and Weaver receiver
  - C. Polyphase Filter
- III. Integrated Low Noise Amplifier (LNA) Design**
  - A. Input matching for integrated LNA
  - B. Integrated LNA topologies, common gate, common source, inductive degeneration LNAs
  - C. LNA design examples, transformer coupled, noise cancellation LNAs
- IV. Integrated Mixer Design**
  - A. Integrated passive and active mixer design and comparison, linearity, noise analysis. Noise folding effects
  - B. Mixer linearization and noise improvement techniques, source degeneration, offset transconductance
- V. Voltage Controlled Oscillator (VCO)**
  - A. Review of oscillator and VCO model
  - B. Phase noise generation mechanism, analysis and effects
  - C. Quadrature signal generation
- VI. Phase Locked Loop (PLL) and Components**
  - A. Type-I and Type-II charge pump PLL
  - B. Dividers including static, dynamic and programmable dividers
  - C. Phase Frequency Detector and Charge Pump design and nonidealities
  - D. Phase noise contribution and analysis from individual blocks
- VII. Advanced Topics: Synthesizers or Power Amplifier**

### Textbooks:

“RF Microelectronics” Behzad Razavi, 2<sup>nd</sup> Edition, 2012

“The Design of CMOS Radio-Frequency Integrated Circuits” Thomas Lee, 2<sup>nd</sup> Edition, 2003