Integrated RF Circuits and Systems Design

Department of Electrical Engineering
Amirkabir University of Technology
Instructor: Dr. Mohammad Yavari
Fall 2020

Topics:

1. **Introduction to Radio Communications**
2. **Review of CMOS Technology and Device Modeling for High-Speed Applications**
3. **Basic Concepts in RF Design:** Effects of Nonlinearity, Noise Modeling in Amplifiers, Noise Figure, Sensitivity and Dynamic Range, Passive RLC Circuits and Impedance Transformation, Scattering Parameters and Smith Chart, Integrated Passive Components
4. **Transceiver Architectures:** General Considerations, Receiver Architectures (Heterodyne, Direct Conversion, Low-IF, Image Reject, Digital-IF, Subsampling, …), Transmitter Architectures (Direct Upconversion, Two-Step Transmitters, …)
5. **Low Noise Amplifiers (LNAs):** LNA Design Metrics and Stability Factors, High-Speed Broadband and Narrowband Amplifiers, Narrowband and Wideband LNA Topologies, CMOS LNA Design
6. **Mixers:** General Considerations, Passive Downconversion Mixers, Active Downconversion Mixers, Improved Mixer Topologies, Upconversion Mixers
7. **Oscillators:** Basic Principles and Performance Parameters, Topologies (Ring, Colpitts, VCO, Quadrature, …), Noise in Voltage-Controlled Oscillators (Phase Noise, …)
8. **Power Amplifiers:** General Considerations, Different Classes of Operation, Linearization Techniques

Texts:

1. Behzad Razavi, *RF Microelectronics*, Upper Saddle River, Prentice Hall, 2nd edition, 2012.
2. Thomas H. Lee, *The Design of CMOS Radio-Frequency Integrated Circuits*, 2nd edition, Cambridge Univ. Press, 2004.

References:

3. F. Ellinger, *Radio Frequency Integrated Circuits and Technologies*, Springer-Verlag, 2007.
4. A. M. Niknejad, *Electromagnetics for High-Speed Analog and Digital Communication Circuits*, Cambridge Univ. Press, 2007.
5. B. Leung, *VLSI for Wireless Communication*, Upper Saddle River, Prentice Hall, 2002.
6. J. Rogers and C. Plett, *Radio Frequency Integrated Circuit Design*, Artech House, 2003.
7. K. Shu and E. Sanchez-Sinencio, *CMOS PLL Synthesizers: Analysis and Design*, Springer, 2005.
8. T. Ytterdal, Y. Cheng, and T. A. Fjeldly, *Device Modeling for Analog and RF CMOS Circuit Design*, Wiley & Sons, 2003.
9. Class Notes and Selected Publications

Requirement:

Electronics III

Grading:

Homeworks: 10%

Projects: 15%

Midterm: 35%

Final: 40%