

ECE 642: Radio Frequency Integrated Circuit Design

Transistor-level design of circuits for wideband RF and high-speed data communication front-ends. On-chip passive component design and simulation aimed at maximizing RF performance are described in detail. Circuit examples include: wideband preamplifiers and gain blocks, I-Q up/downconverters, voltage- and digitally-controlled oscillators (VCO/DCO), and power amplifier drivers. Design of circuit blocks for mm-wave frequency applications, RF testing, packaging and characterization are also discussed, time permitting.

Office Hours

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Timetable (Jan. 9-Apr. 5, 2018): [REDACTED] [REDACTED]
[REDACTED] [REDACTED]

Prerequisites: ECE 632 and ECE 331 (or equivalents); SPICE simulation experience.

Week

Lecture Topics

- 1,2 Overview of radio-frequency integrated circuits (RFIC). Circuit design review. Assignment #1: Review problems.
- 3,4 Characterization of silicon MOSFETs and SiGe-HBTs, and CMOS/BiCMOS technologies for RF and high-speed applications. Feedback methods in RF circuit analysis. Low-noise and wideband preamplifier design. Assignment #2: Low-noise amplifier (LNA).
- 5,6 On-chip passive components: capacitors, varactors, resistors, interconnect and transmission lines, inductors, transformers. Assignment #3: On-chip passive component simulation and design.
- 7,8 Oscillators. L-C oscillator topologies. Resonant tanks and oscillator tuning. VCO/DCO design for RF transceivers up to mm-wave frequencies. Assignment #4: VCO/DCO design for PLL synthesizers.
- 9,10 Up and down conversion mixers. Linear multipliers. Mixer input and commutation stages. RFIC approaches for low voltage/low power and high linearity mixing. I/Q mixers and quadrature up/downconversion. LNA/mixer interfacing. Assignment #5: IC mixer design.
- 11,12 RFIC design for mm-wave frequency applications. Course wrap-up.

References:

1. B. Razavi, RF Microelectronics, 2nd ed., Prentice-Hall, 2011.
2. D. Pozar, Microwave Engineering, 4th ed., Wiley, 2011.
3. S.P. Voinigescu, High-Frequency Integrated Circuits, 1st ed., Cambridge University Press, 2013.
4. RFIC Virtual Journal: <http://ieeexplore.ieee.org/virtual-journals/rfic>

Also: IEEE Journal of Solid-State Circuits and Transactions on Microwave Theory and Techniques; Proceedings of the ISSCC, RFIC Symposium, CICC, ESSCIRC, and BCICTS conferences.

Assignments: 5 for 50% total (hand-in of all assignments required, late work penalty is 5% per day)

Examination: 50% final (open book)