Course Outline, Telecommunication Circuits, ELEC 4505, Fall 2012

Instructor: Prof. Calvin Plett, **Office:** 5148 ME or 5170 ME,

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Lectures: Tue, Thur 11:30-13:00, room 4342 ME, (Term is Sept 6 – Dec 3, 2012)

Labs: Mon 8:30-11:30, Tue 14:30-17:30, Fri 8:30-11:30, Odd Weeks room 4135 ME

Marks: Lab 35%, Assignments 15%, Final 50% (must get at least 35/100 in final exam)

Academic accommodation for any reason must be sought as soon as possible, preferably early in the term. Verification will be required.

Course Description: Design of circuits making up the blocks in a communication system. Examples of such blocks are tuned amplifiers, mixers, oscillators, phase shifters and detectors. Communications systems considered are wireless transceivers, AM, FM and TV. Use of the PLL will be discussed.

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Labs:

Group size is 2 for all labs, one write-up per group, due at 4:14 PM one week after the scheduled lab day. Lab 3 has two parts, done in weeks 9 and 11, the write-op combines both parts and is due in week 12. (Note that unlike labs, assignments are done individually.)

1. **Tuned Amplifiers (Simulation Lab) (and Assignment 1)** (introduction: Week 1 Sept. 10, 11, 14, Lab 1 (and Assignment 1): Week 3 Sept 24, 25, 28) **115**
   Design and simulation (in ADS) of a 1.1 MHz tuned amplifier, built with a bipolar transistor and passive components. You will learn about the use of transistor parameters, tuned circuits, noise figure and impedance matching.
2. **Mixers and Modulators (Hardware Lab)** (Week 7 Oct. 22, 23, 26) **127**
   Use of an analog multiplier on an IC to build frequency changers. DSBSC, filtering for single sideband.
3 **Phase-Locked Loops (Hardware Lab)** (Week 9 Nov. 5, 6, 9 and Week 11 Nov. 19, 20, 23) **144**
   Use of a commercially available package to build a tracking filter, a synthesizer and an FM demodulator. The IC contains a voltage-controlled oscillator and phase detectors. In this lab, the VCO and phase detectors will be characterized, then a complete phased-locked loop will be built. The main external components will consist of a simple active loop filter and a divider to realize the synthesizer.

Assignments: Assignment 1 is part of Lab 1, Assignment 2 in Week 5 is an oscillator simulation, and Assignment 3 is on PLLs and is related to Lab 3 and done in parallel with it. Note that unlike labs, assignments are done individually.

Course Notes, Lab Notes, Assignments, extra info (past exams, lab hints, marking schemes): Will all be available on a password protected course web page

Course Goals

The objective of this course is to learn about the design of communications circuits with topics as described in the above outline of the Lectures, Labs, and Assignments.

Student Learning Objectives

Upon successful completion of this course, students will be able to:

1. Understand the need in a communications system for amplification, filtering, mixing, signal generation, modulation, detection, and data conversion.
2. Understand how performance of telecommunications circuits is limited by parasitic capacitance, unwanted resistance, nonlinearity, and noise, and how to apply design principles to deal with such nonidealities.
3. Design tuned amplifiers and apply them in a communications system.
4. Design mixers and apply them in a communications system.
5. Design oscillators and apply them in a communications system.
6. Design PLL-based circuits such as a tracking filters, FM demodulators and frequency synthesizers

References:

Smith, *Modern Communication Circuits 2nd Ed*., McGraw-Hill 1998, TK6553.S5595

Krauss, Bostonian, Raab, *Solid State Radio Engineering*, Wiley 1980, TK6553.K73

Plett, Rogers, *Radio Frequency Integrated Circuit Design*, 2nd Ed. Artech House, 2010, TK7874

Sedra, Smith, *Microelectronic Circuits*, (for introduction to tuned amplifiers, oscillators)

Stremler, *Introduction to Communication Systems*, (or other introductory communications texts)

Signetics, *Linear Data Manual Volume 1: Communications*, 1987 (or other data books)