

## Course Outline, Telecommunication Circuits, ELEC 4505, Fall 2011

**Lectures:** Tue, Thur 1:00-2:30, room 4494 ME, (Term is Sept 8 – Dec 5, 2011)

**Labs:** Mon 11:30-14:30, Mon 14:30-17:30, Thu 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 Objective:** To learn about the design of communications circuits. In other courses, the block diagrams have been seen, but here, emphasis will be on the actual circuitry which makes up these blocks. 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.

<u>Course Outline:</u>	<u>Page</u>
<b>1. Introduction to Telecommunications</b> Components of a radio systems; noise, distortion impedance matching.	<b>1</b>
<b>2. Amplifier Design</b> Tuned amplifiers, class C amplifiers, extension to frequency multipliers.	<b>17</b>
<b>3. Mixers and Modulators</b>	<b>39</b>
<b>4. Phase-Locked Loop and Applications</b> Introduction to PLLs and applications such as: synthesizers and FM demodulation.	<b>47</b>
<b>5. Oscillators (For 2011, done after Amplifiers, before Mixers)</b>	<b>72</b>
<b>6. Amplitude-Modulated Radio</b>	<b>83</b>
<b>7. Frequency Modulators and Demodulators</b>	<b>89</b>
<b>8. Television Systems</b> Transmission and reception of video and audio; May also discuss high-definition TV, stereo sound.	<b>102</b>

### Labs:

Group size is 2 for all labs, one writeup per group, due one week after scheduled lab day, 4:15 PM. (Note assignments are done individually.)

- 1. Tuned Amplifiers (Simulation Lab)** (intro: Week 1 Sept. 12, 15, L1, A1: Week 3 Sept 26, 29) **115**  
Design and simulation (in ADS) of a 7 MHz tuned amplifier, built with a bipolar transistor and passive components. You will learn about use of transistor parameters, tuned circuits, noise figure and impedance matching.
- 2. Mixers and Modulators (Hardware Lab)** (Week 7 Oct. 24, 27) **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. 7, 10 and Week 11 Nov. 21, 24) **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:** Asg1 is an extension of Lab 1, Asg2 in Week 5 is an oscillator simulation, Asg3 is on PLLs.

**Course Notes:** Will all be available on a password protected course web page

### 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*, 2<sup>nd</sup> Ed. Artech House, 2010, TK7874

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

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

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