

## Telecommunication Circuits, ELEC 4505, Fall 2003

**Lectures:** Tue 11:30-1:00, Thur 11:30-1:00, room 3269ME

**Labs:** Wed, Thur, Fri 8:30, Odd Weeks, Room 4125ME

**Marks:** Labs 35% Assignments 15% Final 50% (must get at least 35/100 in final exam)  
(Deferred exams will be harder, because of extra opportunity to study.)  
(As per standard practice in Engineering, students will not be allowed to see their final exam.)

**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>16</b>
<b>3. Mixers and Modulators</b>	<b>34</b>
<b>4. Phase-Locked Loop and Applications</b> Introduction to PLLs and applications such as: synthesizers and FM demodulation.	<b>41</b>
<b>5. Oscillators</b>	<b>66</b>
<b>6. Amplitude-Modulated Radio</b>	<b>77</b>
<b>7. Frequency Modulators and Demodulators</b>	<b>82</b>
<b>8. Television Systems</b> Transmission and reception of video and audio; May also discuss high-definition TV, stereo sound.	<b>95</b>

### Labs

Group size: Simulation - 1, Hardware - 2, one writeup per group, due one week after scheduled lab day, 4:30 PM.

- 1. Tuned Amplifiers (Simulation Lab)** (Sept. 24, 25, 26) **109**  
Use of a bipolar transistor and some passive components to build a tuned amplifier operating at 5.4 MHz. You will learn about use of transistor parameters, tuned circuits and impedance matching.
- 2. Mixers and Modulators (TBD Hardware or Simulation)** (October 8, 9, 10) **119**  
Use of an analog multiplier on an IC to build frequency changers.
- 3. Phase-Locked Loops (Hardware Lab)** (October 22, 23, 24 and November 5, 6, 7) **133**  
Use of a commercially available package to build a tracking filter, a synthesizer and an FM demodulator. The IC contains a voltage-controlled oscillator a phase detector, and amplifiers. In this lab, the VCO and phase detector will be characterized, then a complete phased-lock loop will be built. The main external components will consist of a simple loop filter and a divider to realize the synthesizer.

### References

- Smith, *Modern Communication Circuits 2nd Ed.*, McGraw-Hill 1998, TK6553.S5595  
Hagen, *Radio Frequency Circuit Design*, Cambridge Press, 1997, TK  
Krauss, Bostonian, Raab, *Solid State Radio Engineering*, Wiley 1980, TK6553.K73  
Plett, Rogers, *Radio Frequency Integrated Circuit Design*, Artech House, 2003, TK7874  
Van der Puije, *Telecommunication Circuit Design*, Wiley 1992, TK5103.V  
Sedra, Smith - (for intro to tuned amplifiers, oscillators)  
Stremler, *Introduction to Communication Systems* (or other intro texts)  
Signetics, *Linear Data Manual Volume 1: Communications* 1987