ECE 4710/6713, Communication Systems Engineering – Fall, 2016

Course Description: This course provides a survey of theory and applications relevant to modern communication systems, and attempts to bring students with an undergraduate background in electrical engineering to the state-of-technology. The course covers concepts in deterministic and random signal analysis, link engineering and noise calculations, analog modulation and detection (amplitude and angle modulation), sampling and quantization, digital transmission theory and an overview of satellite systems and spread spectrum systems. Coverage is primarily on the 'physical' layer of communication systems, as opposed to networking issues. We will not be studying any particular technology, e.g. Wi-Fi or satellite broadcasting, in depth, but will use current technology in examples. More advanced treatment of digital communication, including coding techniques, is provided in ECE 7712. More issues related to wireless systems, including propagation, is found in Wireless Communications, ECE 4784/6784. Proficiency with Matlab for simulation of communication systems will be developed through demos and homework assignments.

Important background: Coursework in signals and systems, primarily continuous-time; some exposure to probability theory and random variables. Consult instructor if in doubt.

Instructor: Stephen G. Wilson, Professor of Electrical and Computer Engineering, C-218, Thornton Hall, steve_wilson@virginia.edu, 434-924-6091

Texts: Lecture notes are available on the Collab site, as Parts I and II. Haykin, *Communication Systems*, 4th edition, J.W. Wiley, required

On Combined Sections: Graduate registrants will be typically assigned one additional problem per set, and one additional or more challenging exam problem. Otherwise class requirements and texts are identical .

Outline:

1. The generic communication system: fundamental questions, and tools of analysis. Typical communication system elements and architectures
2. Elements of signal and system theory (review and extension to bandpass case)
3. Link power analysis: guided wave and free-space propagation laws; antenna gain and beamwidth; link equation, power budgets; extension to wireless propagation models
4. Random signals; probability, characterization of random variables, and stochastic processes, Wiener filter
5. Amplitude modulation: DSB-SC, DSB-AM, SSB; spectrum and SNR behavior in noise
6. Angle modulation: FM, PM; spectrum properties and SNR behavior in noise
7. Sampling (incl bandpass sampling) and quantization; PCM applications
8. Baseband digital transmission; matched filter, probability of error, eye pattern, Nyquist pulse shaping, equalization
9. Digital carrier transmission: PSK, FSK, QPSK, QAM; error probability; power spectrum
10. Satellite systems (time permitting), or
11. Spread spectrum technology (time permitting)

Assessment:

- homework (about 7 sets) (42%);
- mid-term exam (25%);
- final exam (30%);
- instructor's reserve (3%)