EE 531 - Communication Theory I – 3 Hours
(old: EE 531 - Communication Theory - 3 Hours)
Elective course

1. *New catalog description*
   Orthogonal signal representation; review of Fourier series and Fourier transform; basic probability theory; random processes; power spectral density; Shannon's channel capacity; sampling theorem; baseband signaling; bandpass signaling; complex envelop representation of signals and systems; analog modulations; binary and M-ary digital modulations; phase locked loops; demodulation circuits; matched filter; error performance in digital communications. Prerequisite: A minimum grade of C in EE 301 and EE 302 or equivalent

(old: 1. *2007-2008 Catalog description*
Optimum filtering; analog and digital communication; detection theory. Prerequisite: EE 530.)

2. *Prerequisites by topics*
   a. Time-domain analysis: Fourier series analysis.
   b. Frequency-domain analysis: Fourier transform, Phasor representation of sinusoids, Z transform
   c. Basic probability theory.

3. *Textbook(s) and/or other required material*
   Required: Digital and Analog Communication Systems, 7th edition, by Leon W. Couch, II, 2007, Prentice Hall..

4. *Class Schedule*
   Three sessions per week, each 50 minutes, for 14 weeks

5. *Topics Covered (Outcomes influenced)*
   - Channel capacity theorem (7 a, b)
   - Communication trade-offs (7 a, b, c)
   - Orthogonal signal representation of signals and noise (7 d, e)
   - Analog passband modulation – AM, PM, FM (7 a, d)
   - Digital baseband modulation – PAM, PCM, ADPCM, DM (7 c, d, f, g, f, i, j)
   - Digital passband modulation – BPSK, ASK, FSK, MPSK, QAM, OFDM, spread spectrum (7 c, d, f, g, f, i, j)
   - Coherent detection, envelope detection (7 c, d, e, f)
   - Phase locked loops (7 d, f)
   - Matched filter (7 d, f, g, h, i)
   - Intersymbol interference (7 a, b, d, f, g)
   - Signal space (7 c, d, e)
   - Maximum likelihood decoding (7 e, f, g, i)
   - Simulation techniques using MATLAB and SIMULINK (7 b, f, g, i, j)

6. *Contribution of course to meeting the professional component*
   Engineering science - 30%, Engineering design - 70%

7. *Course Outcomes (Program outcome contributions): In learning the course topics, the student will attain the following outcomes. (note – graded deliverables measure performance relative to the outcomes)*
   a The student will understand fundamental limits of communication systems. (9 A, B, C, D)
   b The student will understand channel distortions introduced during transmission of information signals. (9 A, B, C, D)
   c The student will understand trade-offs among SNR, bandwidth, and probability of bit error. (9 A, B, C, D)

d The student will represent various baseband and passband signals and systems using phasors. (9 A, B, C, D)
e The student will represent signals in linear vector space. (9 A, B, C, D)
f The student will design analog and digital signal processing circuits. (9 A, B, C, D)
g The student will find optimum receiver structures. (9 A, B, C, D)
h The student will analyze signal-to-noise ratio in analog communication. (9 A, B, C, D)
i The student will analyze probability of bit error in digital communication. (9 A, B, C, D)
j The student will simulate communication systems using simulation software, MATLAB and SIMULINK. (9 A, B, C, D)

8. *Grading policy*

The final grade will be determined by the combined numerical results of all exams, homework scores, and take-home exam problems including computer projects.

Exam 1	25%
Exam 2	25%
Final Exam	30%
Homeworks and computer projects	20%

A grade of C corresponds to meeting the minimum competency required to understand course topics and meet course objectives.

9. Relationship of course to program outcomes

label	Program Outcomes (A Graduate from the program will:)	Contribution
A	have knowledge of the mathematical and scientific foundation of electrical engineering	Strong
B	have knowledge of and the ability to apply techniques and technology of electrical engineering	Strong
C	complete a design project sequence, culminating in a capstone project at or near the professional level	Moderate
D	understand that acquisition of new knowledge is needed for success in the electrical engineering profession	Moderate
E	meet Bradley's general education requirements which are based on the principles of liberal education	NA
F	have experience in communicating technical information and working on teams	Moderate
G	understand the importance of professional and ethical behavior	Moderate

10. *Prepared by*: In Soo Ahn Date: 5/21/2008