FACULTY OF ENGINEERING AND APPLIED SCIENCE
MEMORIAL UNIVERSITY OF NEWFOUNDLAND

ENGI 9872: DIGITAL COMMUNICATIONS

FALL 2009

DESCRIPTION AND OBJECTIVE:

This course introduces basic principles of the analysis and design of modern digital communication systems. The necessary prerequisites are fundamentals of signals and systems, probability and random processes. A short review of these subjects will be provided in the course. Topics include baseband and passband modulation techniques, receiver design, performance analysis, and equalization techniques. Principles of wireless communication system design are also explored. The mobile wireless environment is characterized and tools for communications in this environment developed.

Upon completion, the students should be able to apply the principles of digital communication theory to the field of engineering.

COURSE INFORMATION:

Class Time: Monday and Wednesday, 5:00 pm -6:15 pm
Class Location: EN 4008

Instructor: Octavia Dobre
Email: odobre@ mun.ca, Tel: 737-4045, Office: EN 3015
Office Hours: Tuesday and Thursday, 5:00 pm-6:00 pm, and by appointment

Textbook:

- J. G. Proakis and M. Salehi, *Communication Systems Engineering*. 2nd ed., Prentice Hall, 2002.

Supplemental References:

- J. G. Proakis, *Digital Communications*. 4th ed., McGraw-Hill, 2001.
- M. K. Simon and M.-S. Alouini, *Digital Communication over Fading Channels: A Unified Approach to Performance Analysis*, John Wiley, New York, 2000.
- T. S. Rappaport, *Wireless Communications: Principles and Practice*. 2nd ed., Prentice Hall, 2001.
- Research papers in the field from the IEEE/IEE publications.

Evaluation:

15% Assignments (3)
20% Project
25% Midterm Exam
40% Final Exam

DETAILED COURSE OUTLINE:

- **Brief Review**: Frequency domain analysis of signals and systems; Random processes.
- **Digital transmission through the additive white Gaussian noise (AWGN) channel**: Geometric representation of signal waveforms; Pulse amplitude modulation; Two-dimensional signal waveforms; Multidimensional signal waveforms; Optimum receiver for digitally signals in AWGN; Probability of error for signal detection in AWGN; Symbol and time synchronization (if time permits).
- **Digital transmission through bandlimited AWGN channel:** Power spectrum of digitally modulated signals; Signal design for bandlimited channels; Probability of error in signal detection; Equalization.
- **Wireless Communications**: Characterization of fading multipath channels; Diversity techniques for fading multipath channels; Digital signaling over a frequency-selective, slowly varying fading channel; Spread spectrum communication systems.

ASSIGNMENTS:

There will be 3 assignments, which will be due at the beginning of the class on the following tentative dates: October 7th, November 9th, and November 25th.

Late assignments are accepted under penalty, as follows. Assignments handed in later than the class time (after 6:15 pm) on the due date, will incur a penalty of 50%. Assignments handed in after 5:00 pm the day after the due date will receive no credit.

Late assignments will be turned in to me in my mailbox (#37), in the General Office.

Students must work individually on assignments. Please, solve the problems in the order assigned and write legibly. Each assignment must have a cover page, with the student name, due date and assignment number. All pages have to be stapled together.

PROJECT:

A group project which illustrates important aspects of analysis and simulation of digital communication systems is required in this course. Performance of communication links will be evaluated for various modulation formats using simple channel models. Simulations will be carried out in Matlab. Detailed instructions will be provided in class.

A short report (10-20 pages) needs to be submitted, including results of simulations, discussions and conclusion. The Matlab code will be enclosed as an appendix. Reports should be submitted before December 2nd.

EXAMS:

There will be a midterm exam during the class (75 minutes) on October 14th (tentative date). The course will conclude with a comprehensive final exam, during the week of exams.

Both exams will be closed book and notes. Only non-graphing calculators, without text storage or communication capability will be allowed.