ENGR 4130U Digital Communications (Fall 2009)

Instructor: Prof. Min Dong
Faculty of Engineering and Applied Science
Office: U5-25
Tel: (905) -721-8668 ext. 3840
Email: min.dong@uoit.ca

Lectures: M: 11:10 –12:30 @ UA3120; R: 12:40 – 2:00 @ J127

Course Website: WebCT

Office Hours: R: 2:00PM – 3:00PM, or by appointment

TA: Fayyaz Ahmud (ahmedf42@mcmaster.ca)
Tutorial: T: 5:10-7pm @ UL10

Prerequisites: ENGR 3070U and ENGR 3130U, or equivalent; If you are not sure whether or not classes from other universities satisfy the prerequisites, speak with the professor.

Textbooks: 1. Lecture notes and handouts
2. *Digital Communications*, by John Proakis and Masoud Salehi, 5th edition, McGraw Hill 2008 (in Library reserve)

Reference Books:

1. *Digital Communications: Fundamentals and Applications*, by Bernard Sklar, Prentice Hall 2001
2. *Principles of Communication Engineering*, J.M. Wozencraft and I.M. Jacobs, Wiley, 1965
(Reference books are available in the Library)

Course Objectives: This course covers topics related to point-to-point reliable transmission of digital data streams. After completing this course, students should understand fundamental principles and essential components of modern digital communications; understand system-level transmitter and receiver designs and be able to apply related knowledge to such designs for practical communication links; be able to quantify and evaluate the performance of communication systems, as well as delineate and optimize tradeoffs under various channel conditions.

Course Description: Fundamentals of digital communications. Topics include: random process models of modulated signals and noise; optimal receivers for digital transmission through additive white Gaussian noise (AWGN) channels, matched filters; digital transmission through band-limited AWGN channels, inter-symbol interference (ISI), equalization techniques; concept of information theory, coding and channel capacity; multicarrier transmission.

Course Outline:

1. *Introduction to digital communications*
   Course overview; Communication system overview.
2. *Review of probability and random processes*
   Probability and random variables; Basics of random processes; Power spectrum; Band-limited process and sampling; Bandpass processes.
3. *Modem for AWGN channels*
   Signal space theory. MAP and ML detection. Error probability of different modulations. Coherent and noncoherent detection. Waveform channels and passband transmissions.
4. *Modem for band-limited channels*
   Band-limited channels and Nyquist criterion. Maximum likelihood sequence estimation. Linear and decision feedback equalization. Multicarrier transmission.
5. *Concept of information theory: coding and channel capacity*
   Entropy and mutual information. Discrete memoryless channel. Random coding bounds. Error exponent and cutoff rate. Capacity of AWGN channels.

Grading:

Homework	10%
Project	15%
Midterm exam	35%
Final exam	40%

Course Policies:

***Attendance*:** Attendance is expected during the lecture offering period. Students are responsible for all assignments and announcements made in class, and all material covered in class, whether or not it is in the textbook. Please check the course website at webCT regularly for announcement and homework assignments.

***Homework*:** Homework will be assigned roughly on a biweekly basis. Due date will be specified on each homework assignment. Late submission will not be accepted unless prior arrangements are made with me at least 1 day in advance. Each student must have his/her own contribution and should independently write up the homework. Discussion on the problems is permitted, after each student has worked out the problem individually. Problem solutions will be posted on the course website. The assigned problems will reflect the types of questions given in the midterm and final exams.

***Midterm and Final Exams*:** Closed-book and close-note exam. Midterm will be in class exam. Students are allowed to bring one 8.5x11 double-sided study sheet. It is the university policy that every student must bring his/her own student ID to the exam. Fail to do so will fail the course.

- Midterm exam: Tuesday, October 27, tutorial time (tentative)
- Deferred Midterm exam:
  - Medical certificates MUST be sent DIRECTLY from the Doctor's Office or

Hospital within 5 days by mail or preferably by fax to the Academic Advisor of FEAS (fax number 905-721-3370 attn: Academic Advisor).

- A fee for the deferral must be paid by the student if the Medical certificate is valid and arrives on time.
- Failure to comply with the above will result in an F for the mid-term and/or the final exam.

Project: The objective of the final project is to gain some experience in implementing a few algorithms widely used in practice in digital communication systems. A project report is expected which includes simulation results, verification with theory, and discussion of your observations. The project is expected to be conducted individually.

Computer Experience: The Matlab and Toolboxes will be used in completing the homework and the final project. The software will be used to learn computer-based simulation of digital transmission, basic modulation/demodulation techniques, and analyze the performance. WebCT will be used to provide course material and assignments.

Integrity and Honesty**:** Academic misconduct impedes the activities of the University community, and is punishable by appropriate disciplinary action. Students are encouraged to read statements on academic misconduct, including plagiarism, cheating, and examination impersonation in the University calendar
http://www.uoit.ca/EN/academicintegritystudent/main/225530/uoit_policies.html.
Any academic misconduct will be dealt according to the relevant portions of section 5 of the calendar. Academic misconduct includes, but is not limited to, the provisions detailed in section 5.15.1. Please read them carefully.

Note: The above topics and outline are subject to adjustments and changes as needed