EE4TK4–Digital Communication Systems
Course Outline: 2013-14

Instructor: Dr. K. M. Wong, PEng. Rm ITB–A309, ex 24098, wong@mail.ece.mcmaster.ca

Teaching Assistants: Z. Dong, M. Razeghi, J. Xu

Schedule: Three lectures and one two-hour tutorial per week.

Calendar Description:
Digital modulation systems, intersymbol interference, equalization, synchronization; ASK, FSK, PSK, MSK, optimum receiver, non-coherent detection; introduction to information theory; entropy, source coding, mutual information, channel capacity; introduction to channel coding, linear block codes, cyclic codes, convolutional codes.

Course Objectives: To understand the basic structures and fundamental principles of modern digital communication systems, and to learn the commonly used techniques of modulation, source coding, and channel coding. Also, to understand the concepts of information, entropy and channel capacity use them to study communications and coding.

Outline of Topics:

Introduction (1 hour) – General concept of digital communication systems

Digitization of Signals (2 hours) – Sampling, quantization; Companding

Digital Transmission Systems (4 hours) – PCM, Delta modulation; Adaptive delta modulation; Differential PCM.

Intersymbol Interference (4 hours) – Non-ideal channel transmission, Eye diagram, pulse shaping, adaptive equalization, partial response signaling

Synchronization (1 hour) − Bit synchronization, word synchronization.

Optimal Receiver Design (6 hours) Matched filter, bit error rate; Coherent receivers: ASK, FSK, PSK modulations; Incoherent receivers: ASK, FSK, PSK modulations; Differential PSK modulation.

Detection of *M*-ary signals (3 hours)

Elements of Information Theory (4 hours) – Entropy for discrete signals; Randomness; Self information, mutual information; Entropy rate for Markov sources.

Source coding (3 hours) – Huffman coding; Shannon-Fano coding; Shannon's first theorem

Channel capacity (4 hours) – Entropy for continuous random variables; Channel capacity; Shannon's second theorem; Capacity of a band-limited Gaussian channel.

Channel coding (7 hours) – Error correcting codes; Linear block codes; Cyclic codes; Convolutional codes; Viterbi's decoding algorithm.
(Total Course = 39 hours)

Format: Lectures (whole class); Tutorials (whole class); Projects (individual).

Assessment:
One two-hour term tests –20%.
Two project reports – each 12%.
Participation and tutorial – 6%
Final examination – 50%.

Calculator requirement for tests and examinations: The McMaster Standard Calculator (Casio fx991)

Resources: K.M. Wong, *Lecture Notes on Digital Communications*, Courseware, McMaster University, 2013.

Policy Reminders:
    Senate and the Faculty of Engineering require all course outlines to include the following reminders:

    "The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible."

    "Students are reminded that they should read and comply with the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available in the Senate Office."

    "Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at
    http://www.mcmaster.ca/senate/academic/ac_integrity.htm

    The following illustrates only three forms of academic dishonesty:

        1   **Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.** (*Insert specific course information, e.g. style guide*)
        2   **Improper collaboration in group work.** (*Insert specific course information*)
        3   **Copying or using unauthorized aids in tests and examinations.**

    (*If applicable*) **In this course we will be using a software package designed to reveal plagiarism. Students will be required to submit their work electronically and in hard copy so that it can be checked for academic dishonesty."**

_____

Note on Calculators: If the use of a calculator is to be allowed on tests and examinations, the new Senate Policy on Calculators requires an instructor to specify on the course outline which of the following options apply to your course:

a.   The McMaster Standard Calculator (Casio fx991) may be used on tests and examinations, or
b.   Any calculator can be used on tests and examinations.

The second option is to be chosen only when the instructor is sure that no student will have an unfair advantage over other students due to the possession of a particular calculator.