Marquette University
Department of Electrical and Computer Engineering
Fall 2019

ELEN4590/EECE5590 Developments in Communications: Digital Communications

Course goal:

To understand the fundamentals of digital communications and how they are used in today's practical communications systems.

Course description:

Review of signals and stochastic processes; digital modulation schemes; source coding; optimum receiver for additive white Gaussian noise channels; channel models and channel capacity; synchronization; error control coding; communication through bandlimited channels; equalization; and introduction to multiple-access techniques.

Prerequisites:

ELEN 3020, and preferably an introductory course on communication systems (e.g., ELEN 4560).

Instructor:

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Classroom & time

Building: Olin Engineering 119; TuTh: 5:30P–6:45P

Office hours

T: 2:00–3:00 & W: 10:00–11:00.

Textbook:

Digital Communications: Fundamentals and Applications, second edition, by Bernard Sklar. Prentice Hall, 2001. Required.

Course objectives:

- Understand the building blocks of a communication system: knowing the big picture
- Understand how information is formatted into a digital format prior to transmission
- Understand the various digital modulation schemes, and their bandwidth properties
- Understand demodulation methods and assess quantitatively the performance of digital receivers
- Be able to perform communication-link analysis and compare various modulation schemes

- Become familiar with the concept of channel distortion and channel capacity, and how one can compensate for distortion through channel coding
- Become familiar with the properties of the key error-correction coding methods
- Understand the tradeoff between modulation (to maximize transmission rate) and coding (to minimize the error in detected symbols)
- Understand how data compression (a.k.a source coding) works and what its fundamental limit is
- Understand how multiple users can share the same channel without interference

Course outline:

1. Signals and spectra (Ch. 1). This chapter includes a review of concepts from signals and stochastic processes.
2. Formatting and baseband modulation (2.1–2.8)
3. Baseband demodulation/detection (3.1–3.4)
4. Bandpass modulation and demodulation/detection (4.1–4.9)
5. Communication link analysis (5.1–5.8)
6. Channel coding: Fundamentals and examples of block codes. (6.1–6.8)
7. Channel coding: Convolutional codes and turbo codes (7.1–7.4;8.4)
8. Modulation and coding tradeoffs (9.1–9.9)
9. Synchronization (10.1,10.2)
10. Principles of compression and source coding (13.1,13.2,13.7,13.8)
11. Basics multiple access techniques and spread spectrum (11.1,11.2;12.1–12.4,12.7,12.8)

Computer and system simulator usage:

Some homework assignments require the simulation of modulation, transmission, noise and random signals, and the empirical assessment of the performance of certain communication systems. Generation and performance analysis of certain error-correcting codes and source codes also require computer programming. Students are expected to be familiar with Matlab.

Course requirements:

• 30% Homework & computer assignments.
Assignments are due in class in the beginning of the period. Late assignments are penalized 10% the first day and 5% each additional day, up to a maximum penalty of 50%. Late assignments will not be accepted past the last class day or if solutions have been posted.

• One midterm examination, 35% each.

• 35% Final examination.

Tentative grading policy:

93–100: A
90–92: A-
87–89: B+
83–86: B
80–82: B-
77–79: C+
73–76: C
70–72: C-
67–69: D+
63–66: D
60–62: D-
59 or below: F

Honor code

Students are expected to comply with Marquettes Honor Code And Honor Policy:
http://bulletin.marquette.edu/undergrad/academicregulations/ and
http://www.marquette.edu/provost/integrity-index.php

- Exchange of information during exams is strictly prohibited. Specifically, unless specified otherwise by the instructor, the use of graphing calculators, cell phones or Smart Watches are prohibited during exams.
- Students are encouraged to discuss their homework assignments with the sole goal of learning from one another. Each student, however, is expected to creates his/her own solution in an original manner.
- Unless related to course activities, the use of internet browsing, texting, facebooking, tweeting, instagramming, snap chatting, etc., during lectures and labs is prohibited. It will prevent you from engaging with the class and will distract other students.