CALENDAR/COURSE DESCRIPTION

Digital modulation systems, intersymbol interference, equalization, synchronization; ASK, FSK, PSK, MSK, optimal receiver, noncoherent detection; introduction to information theory; entropy, source coding, mutual information, channel capacity.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s):
Registration in level III or greater in any Computer or Electrical Engineering Program; ELECENG 3TR4

SCHEDULE

Lectures: Monday, Wednesday & Thursday 10:30 am – 11:20 pm
Tutorial: Thursday 11:30 am – 1:20 pm
Labs: (none)

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. JK Zhang
ITB-A220
jkzhang@mail.ece.mcmaster.ca
ext. 27599

Office Hours:
Thursday – 2:30-4:30 am
Friday– 2:30 -3:30 pm
Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Ben Liu
ITB-A202
Liu61@mcmaster.ca
ext. 23151

Xiaoxuan Chu
ITB-A204
Chx7@mcmaster.ca
ext. 24087

Office Hours:
Wednesday-2pm
Thursday-2:30pm

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://avenue.mcmaster.ca/

COURSE OBJECTIVES
By the end of this course, students should be able to:

- understand the basic structures and fundamental principles of modern digital communication systems;
- learn the commonly used techniques of modulation, source coding and channel coding;
- understand the concepts of information theory, entropy and channel capacity and use them to study communications and coding.

### ASSUMED KNOWLEDGE

Fundamental probability theory, linear algebra and calculus.

### COURSE MATERIALS

**Required Texts:** K.M. Wong, Lecture Notes on Digital Communications, Courseware, McMaster University, 2015.

**Calculator:**

Only the McMaster Standard Calculator (Casio FX-991 MS or MS Plus) is permitted in tests and examinations. This is available at the Campus Store.

**Other Materials:**


### COURSE OVERVIEW

<table>
<thead>
<tr>
<th>Date/Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>General concept of digital communication systems, Sampling, Quantization, Companding</td>
</tr>
<tr>
<td>Week 2</td>
<td>PCM, Delta modulation; Adaptive delta modulation, Differential PCM.</td>
</tr>
<tr>
<td>Week 3</td>
<td>Non-ideal channel transmission, Eye diagram, Pulse shaping, Adaptive equalization, Partial response signaling.</td>
</tr>
<tr>
<td>Week 4</td>
<td>Bit synchronization, Word synchronization; Matched filter, Bit error rate.</td>
</tr>
<tr>
<td>Week 5</td>
<td>Coherent receivers: ASK, FSK, PSK modulations.</td>
</tr>
<tr>
<td>Week 6</td>
<td>Incoherent receivers: ASK, FSK, PSK modulations; Differential PSK modulation.</td>
</tr>
<tr>
<td>Week 7</td>
<td>Detection of M-ary signals.</td>
</tr>
<tr>
<td>Week 8</td>
<td>Entropy for discrete signals, Randomness, Self information, Mutual information, Entropy rate for Markov sources.</td>
</tr>
<tr>
<td>Week 9</td>
<td>Huffman coding, Shannon-Fano coding, Shannon’s first theorem.</td>
</tr>
<tr>
<td>Week 10</td>
<td>Entropy for continuous random variables, Channel capacity.</td>
</tr>
<tr>
<td>Week 11</td>
<td>Shannon’s second theorem, Capacity of a band-limited Gaussian channel, Error correcting codes, Linear block codes.</td>
</tr>
</tbody>
</table>
Week 12  Cyclic codes, Convolutional codes, Viterbi's decoding algorithm.

**ASSESSMENT (SUBJECT TO CHANGE)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two projects</td>
<td>30% (each 15%)</td>
</tr>
<tr>
<td>Midterm test (2 hours)</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
</tr>
<tr>
<td>Lecture attendance</td>
<td>8%</td>
</tr>
<tr>
<td>Tutorial attendance</td>
<td>7%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: the attendance weights can be switched to the final exam. The final exam must be written in order to pass the course.

**ACCREDITATION LEARNING OUTCOMES**

Note: The *Learning Outcomes* defined in this section are measured throughout the course and form part of the Department’s continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student’s actual grade in the course. For more information on accreditation, please ask your instructor or visit: [http://www.engineerscanada.ca](http://www.engineerscanada.ca).

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Indicators</th>
<th>Measurement Methods(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To understand the basic structures and fundamental principles of modern digital communication systems.</td>
<td>1.1; 1.3</td>
<td>Projects/Midterm exam/Final Exam</td>
</tr>
<tr>
<td>Solve simple problems including but not limited to the commonly used techniques of digital modulation, information theory, source coding, and channel coding.</td>
<td>2.2</td>
<td>Projects/Midterm exam/Final Exam</td>
</tr>
<tr>
<td>Apply basic digital communication concepts to the study of channel capacity and error performance for various modulation schemes in addition to performing simulations to verify results.</td>
<td>2.2</td>
<td>Projects/Midterm exam/Final Exam</td>
</tr>
</tbody>
</table>

**ACADEMIC INTEGRITY**

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour 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 types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

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.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

**ACADEMIC ACCOMMODATIONS**

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University’s Policy for Academic Accommodation of Students with Disabilities.

**NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK**

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”:
http://www.mcmaster.ca/msaf/.

**NOTICE REGARDING POSSIBLE COURSE MODIFICATION**

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

**Electrical and Computer Engineering Lab Safety**
Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. It is expected that revisions and updates to this document will be done continually. A McMaster University lab manual is also available to read in every laboratory.

General Health and Safety Principles
Good laboratory practice requires that every laboratory worker and supervisor observe the following:
1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.

Location of Safety Equipment

- **Fire Extinguisher**
  On walls in halls outside of labs

- **First Aid Kit**
  ITB A111, or dial “88” after 4:30 p.m.

- **Telephone**
  On the wall of every lab near the door

- **Fire Alarm Pulls**
  Near all building exit doors on all floors
In Case of a Fire (Dial 88)
When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout “Fire!” and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire
Do not use a fire extinguisher on people

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.
Equipment Failure or Hazard
Failure of equipment may be indicative of a safety hazard - You must report all incidents.
Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:
1. Immediately discontinue use of the equipment.
2. In Power Lab, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice
Leave equipment in a safe state for the next person - if you’re not sure, ask!
In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles

<table>
<thead>
<tr>
<th>Role</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>The first point of contact for lab supervision</td>
</tr>
<tr>
<td>ECE Lab Supervisor</td>
<td>Steve Spencer- ITB 147</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:steve@mail.ece.mcmaster.ca">steve@mail.ece.mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Chair</td>
<td>Tim Davidson- ITB A111</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:davidson@mcmaster.ca">davidson@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Administrator</td>
<td>Kerri Hastings- ITB A111</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:hastings@mcmaster.ca">hastings@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Course Instructor</td>
<td>Please contact your specific course instructor directly</td>
</tr>
</tbody>
</table>