Instructor Information and Office hours

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Office hours: Mondays and Wednesdays after the lecture and by appointment

TA Information

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Calendar Information

Introduction to information theory, source coding and data compression, Error control coding, Trellis coded modulation, advanced topics of current interest: spread spectrum; digital wireless communications.
Includes: Experiential Learning Activity
Precludes additional credit for SYSC 4600.
Lectures three hours a week, laboratory three hours alternate weeks.

Prerequisites

SYSC 3503
Students who have not satisfied the prerequisites for this course must either withdraw from the course or obtain a prerequisite waiver by visiting the Engineering Undergraduate Academic Support Office.
Upton entry into this course, students are expected to have knowledge of probability theory and the fundamentals of Communication Theory.

Course Objectives

This course provides an introduction to information theory, source coding and data compression. It also covers the fundamentals of error control coding mainly focused on linear block codes and convolutional codes. Advanced topics of current interest such as the state of the art for channel coding and spread spectrum will be studied.

Learning Outcomes

1. Understand the concept of information, entropy, Shannon limit
2. Be able to find the capacity of variety of discrete channels and the AWGN channel
3. Know the fundamental principle of source coding and particularly design Huffman coding
4. Know block codes, linear block codes, standard array decoding, syndrome decoding
5. Convolution codes, their encoding and Viterbi algorithm
6. The fundamental of Polar codes and design the basic forms of them
7. The basics of spread spectrum and CDMA

Graduate Attributes (GA’s)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. Activities related to the learning outcomes listed above are measured throughout the course and are part of the department’s continual improvement process. Graduate attribute measurements will not be taken into consideration in determining a student’s grade in the course. For more information, please visit: [https://engineerscanada.ca/](https://engineerscanada.ca/).

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<thead>
<tr>
<th>Graduate Attribute</th>
<th>Learning Outcome(s)</th>
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<tbody>
<tr>
<td>2.3 Problem Analysis: Use of assumptions</td>
<td>1, 2, 7</td>
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<tr>
<td>2.4 Problem Analysis: Interpreting the solution – validity of results</td>
<td>1, 2, 4, 5</td>
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<tr>
<td>3.2 Investigation: Design of experiment</td>
<td>3, 5, 6, 7</td>
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<tr>
<td>3.3 Investigation: Experimental procedure</td>
<td>1, 2, 4, 5</td>
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<td>4.7 Design: Evaluation based on engineering principles</td>
<td>3, 5, 6, 7</td>
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Textbooks (or other resources)


Evaluation and Grading Scheme

- Assignments: 2% (5 in total; biweekly)
- Quizzes: 6% (5 in total; dates TBD, in-class, 15 minutes each, best 3 will be selected)
- Project: 10% (will be discussed in details)
- Term Exam: 20% (Monday, November 4th, in-class, 80 minutes)
- Labs: 12% (4 in total)
- Final Exam: 50% (will be scheduled by exam services, 3 hours)

Labs

Sessions: Even Tuesdays, 2:35 pm – 5:25 pm. There will be four software (MATLAB-based) labs each worth 3% of the total mark plus two problem analysis sessions (PASs).
Final Exam

The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

Tentative Week-by-Week Breakdown

W0: Fundamental principles of digital communications and information theory Digital transmission, bandwidth, signal representation, modulation, bandwidth-efficient modulation, signal-space analysis and geometrical representation of signals, detection, maximum likelihood decoding, probability of error, noise, AWGN channel, entropy, Shannon limit, channel capacity theorem, …
W01: Fundamental principles of digital communications and information theory
W02: Source coding
W03: Source coding
W04: Introduction to error control coding; block codes, syndrome decoding, Hamming distance, error detecting and correcting capabilities of block codes, cyclic codes, examples of linear block codes, CRC, ARQ, …
W05: Block codes
W06: Convolutional codes, distance properties, systematic and nonsystematic codes, decoding of convolutional codes, Viterbi algorithm, …
W07: Convolutional codes
W08: Polar codes
W09: Spread-spectrum and CDMA (code-division multiple access)
W10: Spread-spectrum and CDMA
W11: Fading channels and digital wireless communications
W12: Fading channels and digital wireless communications
W13: Overview and wrap-up

General Regulations

Attendance: Students are expected to attend all lectures and lab periods. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 2.1.3, Course Selection and Registration and Section 2.1.7, Deregistration.

Health and Safety: Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf

Deferred Term Work: Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and
in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current *Undergraduate Calendar, Academic Regulations of the University, Section 4.4, Deferred Term Work.*

**Appeal of Grades** : The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the *Undergraduate Calendar, Academic Regulations of the University, Section 3.3.4, Informal Appeal of Grade and Section 3.3.5, Formal Appeal of Grade.*

**Academic Integrity:** Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: [https://carleton.ca/registrar/academic-integrity/](https://carleton.ca/registrar/academic-integrity/). This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

**Plagiarism:** Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

**Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at [http://www.carleton.ca/equity/](http://www.carleton.ca/equity/)

For an accommodation request, the processes are as follows:

- **Pregnancy or Religious obligation:** Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see [https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

- **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your *Letter of Accommodation* at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation *(if applicable).* **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/pmc](http://www.carleton.ca/pmc)) for the deadline to request accommodations for the formally-scheduled exam *(if applicable).*

- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about
the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.

- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

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