

ELEC ENG 4TK4
Digital Communications Systems

COURSE OUTLINE

Please refer to course website for updated information.

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 AND MODE OF DELIVERY

The material for this course will be delivered through a mixture of online videos, textbook readings, live online lectures and tutorials (which are also recorded), and virtualized laboratories and projects. The platform for each component is noted at the end of each line.

Lecture: Monday, Wednesday, Thursday 5:30 pm – 6:20 pm – on Microsoft Teams

Tutorial: Friday 11:30 am – 1:20 pm – on Microsoft Teams

Labs: There are no labs in this course.

INSTRUCTOR

Dr. Jun Chen

Email: junchen@mail.ece.mcmaster.ca

Office: ITB-A221

Phone: 905-525-9140 ext. 20163

Office Hours: by appointment

Please note that during the university closures due to Covid-19 in the Fall Term, instructors will not be in their offices. Please see the course website for clarification on their availability.

TEACHING ASSISTANTS

Contact information and office hours are provided on the course website.

COURSE WEBSITE/S

<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:

Lecture notes will be posted regularly on the course website.

Calculator:

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

Other References:

David Tse and Pramod Viswanath, *Fundamentals of Wireless Communication*, Cambridge University Press, 2005

Robert Gallager, *Principles of Digital Communication*, Cambridge University Press, 2008

Amos Lapidoth, *A Foundation in Digital Communication*, Cambridge University Press, 2008

Robert Gallager, *Information Theory and Reliable Communication*, Wiley, 1968

John Wozencraft and Irwin Jacobs, *Principles of Communication Engineering*, Waveland Press, Inc., 1965

Thomas Cover and Joy Thomas, *Elements of Information Theory*, Wiley, 2006

Raymond Yeung, *Information Theory and Network Coding*, Springer, 2008

COURSE OVERVIEW

Week	Topic	Readings
1	Introduction of digital communications	
2,3	Review of probability theory	Lecture note 1
4,5	Information measures	Lecture note 2
6,7	Channel capacity	Lecture note 3
8	Signalling and coding	Lecture note 3
9	Intersymbol interference and equalization	Lecture note 4
10	Opportunistic communication	Lecture note 4
11,12	Multi-antenna systems	Lecture note 5,6

A more detailed time line is available on the course web site.

At certain points in the course it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on the course website).

ASSESSMENT

Component	Weight
Quiz	10%
One Project	15%
Midterm	0% or 25% (see below)
Final Exam	75% or 50% (see below)
Total	100%

25% of the mark is taken as the best of the midterm and exam. There is no deferred midterm test.

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. It is your responsibility to understand what constitutes academic dishonesty. 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. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online. It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

ACADEMIC ACCOMMODATIONS

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s Academic Accommodation of Students with Disabilities policy.

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

McMaster Student Absence Form (MSAF): 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”.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf>.

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>.

Outcomes	Indicators	Measurement Method(s)
To understand the basic structures and fundamental principles of modern digital communication systems.	1.1; 2.3	Final exam
Solve simple problems including but not limited to the commonly used techniques of digital modulation, information theory, source coding, and channel coding.	2.2; 2.3	Final exam
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.	2.2; 2.3; 4.6	Final exam

www.eng.mcmaster.ca/ece