University of Manitoba

Department of Electrical & Computer Engineering
Graduate Course Outline

FALL 2020

ECE 7440 T 72 - Current Topics in EE: Error Control Codes

COURSE DESCRIPTION:

This course deals with the theory and applications of coding theory in modern communication and distributed storage systems.

COURSE OBJECTIVE:

The objective of this course is to expose the students to the foundations of the classical algebraic coding theory. If time allows, some more advanced coding topics such as turbo, LDPC, polar, and staircase codes as well as coding for distributed storage can be (slightly) covered. As a graduate level course, it will combine extensive reading and in-class discussion of the research literature with research projects done by the students.

The following topics will be covered: finite fields Algebra, Hamming distance, bounds on the minimum distance of block codes, linear block codes, BCH codes, Reed-Solomon codes, convolutional codes, discrete channel and hard-decision decoding, algebraic decoding of BCH and Reed-Solomon codes, convolutional codes over additive white Gaussian noise channels, optimal decoding of convolutional codes (the Viterbi algorithm), turbo codes and iterative decoding, LDPC codes and the sum-product algorithm.

PRE-REQUISITES:

Undergraduate background on digital communications and probability theory.

CONTACT HOURS:

3 hours per week
Day and time: TBD

COURSE CONTENT:

- Part I (Finite fields Algebra): Groups, rings, fields. Arithmetic in Galois fields. Irreducible polynomials and primitive elements. Vector spaces and matrices.
- Part II (practical error control codes): Linear block codes (e.g., Hamming, Reed-Muller, etc.), cyclic codes, BCH codes and Reed-Solomon codes, general theory of MDS codes, convolutional codes, trellis representation of convolutional codes, LDPC and turbo codes (if time permits).

HOMEWORK:

Homework will consist of assignments, preparation of a seminar on an assigned article from the research literature, and an individual design project.

TEXTBOOK:

The following book will be used as the main reference book:

- R. M. Roth, Introduction to Coding Theory, Cambridge, 2006.

The following book is optional:

- T. Richardson and R. Urbanke, Modern Coding Theory, Cambridge, 2012.

GRADE ANNOUNCEMENTS:

TBA – Due to COVID-19, this date to be announced by the Registrar's Office

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination). Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars				
Assignments	4	25%	25	
Project				
Mid-Term Exam	1	25%	25	
Final Examination	1	50%	50	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

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Office Hours:..... By appointment

VOLUNTARY WITHDRAW:

November 23, 2020

REQUIREMENTS/REGULATIONS

Student Responsibilities: It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc.

Lectures: Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

ACADEMIC INTEGRITY

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

***Plagiarism:** to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source