University of Manitoba

Price Faculty of Engineering
Department of Electrical & Computer Engineering

Graduate Course Outline

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate and Dene, and on the National Homeland of the Red River Métis.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

Winter 2027

ECE 7560 – Principles of Signal Compression and Coding

COURSE DESCRIPTION: This course provides an introduction to the fundamental principles of lossy signal compression—the process of converting (coding) continuous signals such as audio, images, and video into efficient digital representations for the purpose of storage or communication.

COURSE OBJECTIVE: To develop an in-depth understanding of the theoretical foundations of digital coding of random signals, with applications in audio, image, and video compression.

PRE-REQUISITES: Undergraduate level courses in linear algebra, signal processing, and probability theory, and the ability to program in a language such as Matlab, Mathematica, Python, C, or similar. Although not expected, a background in information theory can be helpful.

CONTACT HOURS: 3-hours per week

COURSE CONTENT:

1. Review of probability; random processes; estimation theory
2. Scalar quantization; optimal quantizers; nonuniform quantization; high-rate theory
3. Vector quantization; an introduction to rate-distortion theory
4. Entropy coding and variable rate quantization
5. Predictive quantization; theory of optimal linear prediction
6. Linear transform coding; optimal and suboptimal transforms
7. Nonlinear transform coding with neural networks; variational autoencoders

HOMEWORK: Assignments to be handed-in.

TEXTBOOKS:

1. A. Gersho and R. M. Gray, “Vector Quantization and Signal Compression,” Kluwer Academic Press/Springer, 1992.
2. W. A. Pearlman and A. Said, “Digital Signal Compression”, Cambridge University Press, 2012.
3. K. Sayood, “Introduction to data compression,” Morgan Kaufmann, 2017.

GRADE ANNOUNCEMENTS:

Grades for this course will be announced by April 2027

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
Assignments	3	30%	30	
Project	1	20%	20	
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:

Name:..... Pradeepa Yahampath
Office:..... EITC E1-536
Tel:..... 204 474 8784
Email:..... Pradeepa.Yahampath@umanitoba.ca
Office Hours: ..... By appointment

VOLUNTARY WITHDRAW:

March 22, 2027

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

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 on Academic Integrity, students are reminded that plagiarism* or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). **This includes the unauthorized use of AI when preparing course deliverables**. A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. **Integrity also applies to respecting copyrighted course content, which should not be distributed without the creator's permission. Uploading content for the purpose of transcription or other AI-enabled features is commonly a violation of the copyright holder's rights.**

Copyright

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