ENGINEERING 9871: Information Theory and Coding

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Communication *You can come for help during office hours in EN-3049, or by E-mail..*

COURSE DESCRIPTION:

- *This course introduces information and coding theory and associated applications at the graduate level. The topics include probability review, basic concepts, such as entropy and information, data compression, channel capacity, linear block, cyclic and convolutional codes. It will provide the students with the source and channel coding and decoding knowledge required for wireless communications.*
- *Upon completion, the students should be able to understand the principles of information and coding theory, as well as to apply them to the field of communication engineering.*

PREREQUISITES: NA

COREQUISITES: NA

SCHEDULE: LECTURE: T,T 9:00-10:15 pm Room: EN4008

CREDIT VALUE: 3 credits

RESOURCES:

TEXT BOOK

- R. Wells, Applied Coding and Information Theory for Engineers. Prentice Hall, 1999.

REFERENCES

- *S. Lin and D. J. Costello, Error Control Coding: Fundamentals and Applications. 2nd ed., Prentice Hall, 2004.*
- *Research papers in the associated field from the IEEE/IET publications.*

MAJOR TOPICS:

- Introduction
  - Overview of information theory and coding
  - Review of Random variables and probability
- Discrete Sources and Entropy
  - Information sources and entropy
  - Source coding: Huffman, Dictionary, Lempel-Ziv, Arithmetic coding
- Channel and Channel Capacity
  - Channel models
  - Channel capacity
  - Block coding and Shannon's second theorem
  - Markov process and sources with memory
  - Constrained channels
- Error Control Strategies
  - Forward error correction; Automatic repeat request
  - Shannon's limit
  - Channel codes for error control
- Error Detection and Correction
  - Error detection and correction capacity
  - Linear block code: definition and properties, generating, Hamming weight and distance, error detection and correction capacity, decoding
  - Hamming code
- Cyclic Codes
  - Definition
  - Generator and parity-check matrices
  - Encoders for systematic cyclic codes
  - Syndrome computation and error detection
  - Decoding of cyclic codes
- Convolutional Codes
  - Definition
  - Structural property
  - Decoding (Viterbi algorithm: transfer register and trace-back methods)
  - Approaches to increase the code rate: punctured codes

ASSESSMENT:

		Approximate Due Dates
Assignments	15% (5% each)	
Assignment 1		June 10
Assignment 2		July 8
Assignment 3		August 5
Project & presentation	20%	July 31
Midterm	20%	June 26
Final exam	45%	

- *A group project which illustrates important aspects of information and coding theory is required in this course. This could be literature review or simulation experiment on a specific topic related to performance analysis of any coding techniques using simple channel models through latest academic publication reading.*
- *A writing report needs to be submitted by each group (maximum 2 students are allowed in each group), including introduction, problem formulation, results discussions and conclusions. If simulation is undertaken, the Matlab code will be enclosed as an appendix. Reports should be submitted before July 25th.*
- *There will be one midterm test and one final. Final Exam will be cumulative, meaning that they will test the material covered by the text, notes and assignments from the beginning of the course up to the end.*
- *To ensure fairness across the class and fairness in the assessment of tests/exams, only ordinary scientific calculators will be permitted. These are calculators which are non-programmable, without plotting capability, without the ability to perform symbolic computation, and which cannot store text. Calculators will be checked at these tests/exams to ensure they conform to these guidelines. Formula sheet will be attached to the exam paper.*

ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at www.engr.mun.ca/undergrad/academicintegrity.

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at http://www.engr.mun.ca/policies/codeofconduct.php and Memorial University's Code of Student Conduct at http://www.mun.ca/student/home/conduct.php.

Instructors are encouraged to include more detailed, course specific comments such as expectations for group/individual work on assignments or labs.

LAB SAFETY:

No lab foe this course.

INCLUSION AND EQUITY:

Students who require physical or academic accommodations are encouraged to speak privately to the instructor so that appropriate arrangements can be made to ensure your full participation in the course. All conversations will remain confidential.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds

that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

STUDENT ASSISTANCE: Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at www.mun.ca/student.