Carleton UNIVERSITY | Department of Systems and Computer Engineering

SYSC 4600
Digital Communications

Calendar description

Review of probability, random variables, signal representation. Baseband data transmission: Nyquist criterion, equalization, optimal receiver, error probability. Digital modulation, performance. Synchronization. Introduction to information theory. Error detection and correction. Spread spectrum. Applications to current digital wired and wireless communications systems.

Includes: Experiential Learning Activity.

Lectures three hours a week, laboratory three hours alternate weeks.

http://calendar.carleton.ca/undergrad/courses/SYSC/

Prerequisites

SYSC 3501 and STAT 3502.

Precludes additional credit for SYSC 3503 and SYSC 4604.

Prior knowledge

Students should:

- Understand concepts that underlie analog and digital communications. These concepts include: Linear systems, Fourier theory, signal bandwidth and spectra, digital waveform coding, analog and digital modulation systems, synchronization, link budgets, communications media and circuits.
- Be able to characterize the effect of noise.
- Understand concepts of probabilities and random variables. These concepts include: conditional probability and independence, distributions (binomial, Poisson, hypergeometric, normal, gamma), confidence intervals.
- Be able to apply/use the central limit theorem, and perform distributions sampling and point estimation (maximum likelihood, method of moments).
- Be prepared to undertake this course that further explores and uses fundamental principles of digital communication systems.

Course objectives

The objective of this course is to introduce the student to advanced topics in modulation and coding. Topics covered includes signal space representation, probability of error and bounds for AWGN channel, applications to PSK, QPSK, FSK, QAM, multicarrier

modulation and OFDM, spread-spectrum communication and CDMA, information theory, source coding theorem, channel capacity, linear block codes and convolutional codes.

List of topics

- Overview of digital communications systems
- Review of probability concepts and stochastic processes
- Review of linear system concepts including frequency analysis
- Baseband transmission and matched filter
- Signal space analysis and geometric representation of signals
- Maximum likelihood detection
- Probability of error
- Bandpass transmission
- Linear clock codes, syndrome decoding, Hamming distance
- Error detecting and correcting capabilities of block codes
- Examples of linear block codes
- Convolutional codes, distance properties, systematic and nonsystematic codes
- Decoding of convolutional codes and Viterbi algorithm
- Introduction to information theory
- Shannon's channel capacity theorem
- Shannon limits. Introduction to source coding

Learning outcomes

By the end of this course, students should be able to:

- Dissect fundamental concepts behind digital communication systems, including: modulation, signal space representation, optimal reception, error probability analysis, and information theory.
- Demonstrate their understanding of mathematical tools such as calculus, probability theory, and Fourier transforms.

Graduate Attributes (GAs)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. There are no GA's related to this course. For more information, please visit: https://engineerscanada.ca/.

Instructor and TA contact

Specific to course offering (tbd)

Textbook (or other resources)

Specific to course offering (tbd)

Evaluation and grading scheme

Specific to course offering (tbd)

Breakdown of course requirements

Specific to course offering (tbd)

Tentative week-by-week breakdown

Specific to course offering (tbd)

General regulations

Specific to course offering (tbd)