

Carleton University
Department of Systems and Computer Engineering
SYSC 5602F: Digital Signal Processing
Fall 2009
Course Syllabus

Instructor: Prof. Richard M. Dansereau
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Course Description and Objectives: Review of discrete time signals and systems, A/D and D/A conversions, representation in time, frequency, and z -domain, DFT/FFT transforms, FIR/IIR filter design, filter structures, quantization effects. Correlation functions. Multi-rate signal processing. Power spectrum estimation. Introduction to joint time-frequency analysis. DSP architecture: implementation approaches. Applications.

Prerequisites: A good knowledge of the continuous-time Fourier transform, Laplace transform, impulse response, frequency response, and probability and statistics, as well as a basic understanding of computer architecture. Understanding of discrete-time Fourier transforms, sampling, and basic digital signal processing an asset.

Textbook:

- J. G. Proakis and D. G. Manolakis, *Digital signal processing, 4/e*, Prentice Hall, 2006.
ISBN 0131873741 (Excellent DSP textbook with good mathematical presentation.)

Alternative Textbook:

- Mitra, *Digital signal processing: A computer based approach, 3/e*, McGraw-Hill, 2005.
ISBN 0073048372 (Excellent DSP textbook which includes many MATLAB examples.)

Grading: Assignments: 25%
Midterm Test (in-class): 25% (date to be determined)
Final Examination[†]: 50%

[†] To obtain a final grade higher than F, students must obtain a passing grade on the final exam.

WWW: Announcements, assignments, and additional material will be posted on the website:

<http://www.sce.carleton.ca/courses/sytc-5602/>

Login: TBA

Password: TBA

Midterm Policy: The Midterm is to be written at the scheduled class time. A missed midterm will be recorded as a zero. If the midterm is missed for circumstances beyond your control, you should submit appropriate documentation within 5 business days for consideration.

Final Exam Policy: The final exam is for evaluation purposes only and will not be returned to the student.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated. Please refer to the section on academic integrity in the Graduate Calendar for additional information.

Health and Safety information: Here is the link to the health and safety manual: www.sce.carleton.ca/courses/health-and-safety.pdf

Students with disabilities: Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities for a formal evaluation of disability-related needs. Registered PMC students are required to contact the Centre, 613-520-6608, every term to ensure that I receive your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you require accommodation for your formally scheduled exam(s) in this course, please submit your request for accommodation to PMC by November 16, 2009. <http://www.carleton.ca/pmc/>

Course Content:

Time permitting, the following topics will be covered:

- Review of discrete-time signals and systems
- Representation in time, frequency, and z -domains
- Impulse response, frequency response
- Shannon sampling theorem, Nyquist rate
- z -transform, region of convergence, inverse z -transform
- Linear discrete-time convolution
- Pole-zero diagrams, stability, causality
- Generalized linear phase filters, group delay
- Frequency selective filters, ideal filters, digital resonators, nulling filters, comb filters
- All-pass, minimum-phase, and maximum-phase filters
- z -domain \leftrightarrow frequency domain relationship
- Discrete Fourier transform (DFT), fast Fourier transforms (FFT)
- FIR filter design, Gibbs' phenomenon
- Windowing, Kaiser filter design
- Equiripple FIR filters, Parks-McClellan filter design
- IIR filter design, impulse invariance, bilinear transformation
- Filter structures, quantization effects
- Picket fence effect, spectral leakage, frequency resolution
- Circular convolution, linear filtering with DFT, overlap-add and overlap-save methods
- Random signals, correlation functions, system identification
- Multi-rate signal processing, digital-to-digital rate conversion, decimation, interpolation, polyphase realizations
- Power spectrum estimation, periodogram, Bartlett method, Welch method, Blackman-Tukey method
- Introduction to joint time-frequency analysis, spectrograms
- MATLAB/Octave implementations