

**Carleton University**  
Department of Systems and Computer Engineering  
**SYSC 4405 B: Introduction to Digital Signal Processing**  
**Winter 2012**  
**Course Syllabus**

**Instructor:** Prof. Richard M. Dansereau  
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Office Hours: To be posted on the course page

**Course Description and Objectives:** The course provides an introduction to digital signal processing (DSP). It covers the basic DSP concepts and methods, such as sampling, discrete-time systems, FIR filters, IIR filters and DFT/FFT algorithms. Emphasis will be on digital infinite impulse response (IIR) and finite impulse response (FIR) filters and applications of the fast Fourier transform (FFT). The relationship between discrete-time and continuous-time signals and systems is emphasized throughout the course. Students will have the opportunity to apply the theory in several laboratory sessions that deal with the design and implementation of basic DSP functions such as FIR and IIR filters as well as spectral analysis using the FFT.

**Prerequisites:** SYSC 2500 or SYSC 3500 or SYSC 3600. Students who have not satisfied the prerequisites must either (a) withdraw from the course or (b) obtain a prerequisite waiver from [www.sce.carleton.ca/ughelp](http://www.sce.carleton.ca/ughelp). Students not meeting these conditions may be deregistered from the course after the last day for course registration.

**Textbook:**

- D. G. Manolakis and V. K. Ingle, *Applied Digital Signal Processing*, Cambridge University Press, 2011. ISBN 978-0-521-11002-0

**Grading:**

Assignments:	20%	
Laboratories:	10%	(compulsory attendance)
Midterm Test (in-class):	20%	(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 and have met all attendance and assignment/laboratory completion requirements.

**WWW:** You must have a CONNECT account to access the course webpage.

<http://webct.carleton.ca/>

Login = Your CONNECT userid

Password = Your existing CONNECT password

The web page will list your official midterm, laboratory, and assignment grades throughout the semester. It is your responsibility to double check that the grades are recorded correctly for your work.

Check the course web page daily for other announcements and postings.

**Health and Safety Information:** Here is the link to the health and safety manual:

<http://www.sce.carleton.ca/courses/health-and-safety.pdf>

**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.

**Attendance:** Lecture attendance and laboratory attendance is *compulsory*. You are expected to attend all lectures and all labs to satisfy attendance requirements. If you must miss a lecture or lab, please email me to see if other arrangements can be made.

**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 academic regulations section of the Undergraduate Calendar for additional information.

**Assignments:** Six to eight assignments are anticipated throughout the semester. The assignments will contain analytical problems as well as MATLAB<sup>TM</sup> based problems, with a focus on using the Signal Processing Toolbox<sup>TM</sup>. Some of the assignments will deal with the design and implementation of FIR and IIR filters. Students are required to complete all assignments, and submit the assignments by the specified due dates to meet the requirements of this course.

**Laboratories:** Lab attendance is a compulsory component of this course. Laboratories will be three hours alternate weeks as per the registration schedule. Check the calendar on the course webpage for the lab schedule. The labs will be held in the *Texas Instruments Embedded Processing Lab* in CB 5107. Six lab sessions are planned for each student and will consist of programming in MATLAB<sup>TM</sup>, developing filter models in SIMULINK<sup>TM</sup>, and using the TI TMS320C6713 DSP starter kit board.

**Course Outline (anticipated):**

- Introductory concepts to digital signal processing  
Discrete-time signals and sequences, unit impulse and unit step functions, properties of systems, filters described by difference equations and block diagrams
- Impulse response, convolution, discrete-time linear convolution, stability in time
- Spectrum representation, sampling, Shannon sampling theorem, Nyquist rate, aliasing
- Frequency response, sinusoidal filtering,  $z$ -transform representation of sequences and filters
- Transfer functions, pole-zero plots,  $z$ -domain  $\Leftrightarrow$  frequency domain relationship
- Stability in  $z$ -domain, frequency response  $\Rightarrow$  impulse response
- FIR filter design, ideal frequency selective filters, FIR filter transformations, FIR windowed filtering
- IIR filter design, Butterworth filters, analog filter transformations
- IIR filter design by impulse invariance, bilinear transformation
- Filter structures, Direct Form I and II structures, cascade structures, parallel structures, discrete Fourier series (DFS), discrete Fourier transform (DFT)
- Discrete Fourier transform (DFT), properties, fast Fourier transform (FFT)
- Introduction to time-frequency analysis issues and spectrograms

**Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

**Pregnancy/parental leave obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website:

<http://www.carleton.ca/equity/accommodation/academic/>

**Religious obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website

<http://www.carleton.ca/equity/accommodation/academic/>

**Students with disabilities** requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 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 only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by the deadlines published on the PMC website:

<http://www.carleton.ca/pmc/students/dates-and-deadlines/>