Course Outline

Instructor: Prof. Mohamed El-Tanany
Room MC7082, Telephone: (613) 520-2600 X5739,
E-mail: tanany@sce.carleton.ca
Office Hours: 2:00 pm - 3:30 pm

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.

Learning Outcomes

- By the end of this course students should be able to
- Understand the differences between analog, discrete time and digital signals.
- Describe and analyze discrete time signals in the time and frequency domains.
- Apply digital signal processing techniques to design discrete time systems.
- Learn the z-transform and its applications in the analysis and design of discrete time systems, and how to use for frequency response computation.
- Design digital filters, meeting given specifications, using windowing techniques.
- Design digital filters using transformation techniques from analog designs.
- Use the Discrete Fourier Transform (DFT) and the FFT for the analysis of arbitrary signals.
- Program digital signal processing algorithms in MATLAB

Prerequisites:
SYSC 2500 or SYSC 3500 or SYSC 3600. Students who have not satisfied the prerequisites must either: (a) withdraw from the course, (b) submit a prerequisite waiver request at www.sce.carleton.ca/ughelp or (c) may be de-registered from the course after the last day to register for courses.

Required Course Material:

Lecture Notes (brief) for SYSC4405 Digital Signal Processing will be made available on the course web page.
ISBN 0-13-187374-1
Suggested References (not mandatory):

Grading:
Assignments 20%
Laboratories: 15%
Midterm Test1: 7.5%
Midterm Test2: 7.5%
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.

Dates for Midterm Tests:
Mid-term test1: Tuesday, February 6th, in-class, 60 minutes.
Mid-term test2: Tuesday, March 6th, in-class, 60 minutes.

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

Health and Safety:
Every student should have a copy of our Health and Safety Manual. An electronic version of the manual can be found at: http://www.sce.carleton.ca/courses/health-and-safety.pdf

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

Attendance:
You are expected to attend at least 90% of all lectures and 100% of all labs to satisfy attendance requirements. If you must miss a lab session, please email me or the TAs of this course to see if other arrangements can be made.

Assignments
Five (5) assignments are anticipated throughout the semester. The assignments will contain analytical problems as well as Matlab based problems, with a focus on using the Signal Processing Toolbox. 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. The labs will be held in the Texas Instruments DSP Lab in CB5107. Five (5) lab sessions are planned for each student which will consist of programming in Matlab, developing filter models in Simulink, and using the TI TMS320C6713 DSP starter kit board.
Lab schedule

L3E   Wednesday 08:35-11:25 CB5107 : W2, W4, W6, W8 and W10

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

Pregnancy 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 see the Student Guide

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 see the Student Guide

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled final exam.

Plagiarism
Plagiarism (copying and handing in for credit the work of someone else) is a serious instructional offense that will not be tolerated. All suspected cases of plagiarism and other instructional offenses, will be forwarded to the Associate Dean of Engineering for investigation. Please refer to the section on instructional offenses in the Undergraduate Calendar for additional information.

Academic Integrity

“Carleton University is a community of scholars dedicated to teaching, learning and research. Sound scholarship rests on a commitment to a code of academic integrity that stresses principles of honesty, trust, respect, fairness and responsibility. The University demands integrity of scholarship from all of its members including students. The quality and integrity of academic work is paramount in achieving student success.

practices undermine the value of the Carleton degree. Dishonesty in scholarly activity cannot be tolerated. Any student who violates the standards of academic integrity will be subject to appropriate sanctions. Students should be aware of their obligations with regards to Academic The University states unequivocally that it demands academic integrity from all its members. Academic dishonesty, in whatever form is ultimately destructive to the values of the University. Furthermore, it is unfair and discouraging to those

students who pursue their studies honestly. The integrity of university academic life and the degrees conferred by the university is dependent upon the honesty and soundness of scholarship. Conduct by any person that adversely affects this process is a serious matter. Students who violate the principles of academic integrity through dishonest Integrity (refer to the Academic Integrity Policy for additional details).

**Course material copyright**

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, labs, case studies, assignments, exams and other materials, are also protected by copyright and remain the intellectual property of their respective author(s). Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not allowed to make electronic recordings (voice and / or video) or take photographs in the class room without the express written consent of the course instructor. The Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).”

1 From the Academic Integrity Policy (found ) at


---

**Topics to Be Covered**

**Week 1**  
Introduction: Logistics, Objectives. Basic Discrete Time Signals and Systems; Sampling and Sequences

**Week 2**  
Discrete time linear time invariant systems: Difference Equations, Impulse Response, Convolution and block diagrams.

**Week 3**  
Initial Condition Response and Stability of linear time invariant systems, Forced and Total response

**Week 4-6**  
The z-Transform, Frequency response of discrete time systems, Filters

**Week 7-10 (IIR) filters**  
Digital Filters: Review of analogue filter theory, Non-recursive (FIR) filters, and Recursive

**Week 10-11**  
Discrete Fourier analysis: Discrete Fourier series, Discrete Fourier Transform and Fast Fourier Transform

**Week 12-13**  
Applications of Digital Signal Processing and Review