Instructor

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

TAs

Abdallah A. Jarwan; abdallhjarwan@cmail.carleton.ca
available for half an hour following each lab

and

Faraj Lagum; Faraj.lagum@sce.carleton.ca
available Mondays 11:30-12-30 in rm MC4038

Office Hours

Office Hours:

Course 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, (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.

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.

Graduate Attributes

- Signals and Systems, Signals and Systems

Textbook and References

Lecture Notes (brief) for SYSC4405 Digital Signal Processing will be made available on the course web page.


Suggested References (not mandatory):

Evaluation and Marking Scheme

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.

**Labs**

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**
L1O (Odd weeks) Monday 08:35-11:25 CB5107:
L1E (Even weeks) Friday 11:35-2:25 CB5107
L2E (Even Weeks) Monday 08:35-11:25 CB5107:

**Exams**

**Dates for Midterm Tests:**

Mid-term test1: The October 18, in-class, 60 minutes.
Mid-term test2: Thu November 15, 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 3 business days for consideration.

**Final Exam:**

The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

**General Regulations**

- **Copyright on Course Materials:** The materials created for this course (including course outline, slides, posted notes, labs, project, assignments, quizzes, exams and solutions) are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).
- **Attendance:** Students are expected to attend all lectures and lab periods. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 1.2, Course Selection and Registration and Section 1.5, Deregistration. Requests to accommodate a missed midterm exam, lab periods, etc., because of conflicts with jobs or vacation plans will not be considered.
- **Health and Safety:** Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: http://sce.carleton.ca/courses/health-and-safety.pdf.
- **Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor.
and in all cases this must occur no later than three (3.0) working days after the term work was
due. The alternate arrangement must be made before the last day of classes in the term as
published in the academic schedule. For more information, see the Academic Regulations of the
University, Section 2.6, Deferred Term Work

- **Appeal of Grades**: The processes for dealing with questions or concerns regarding grades
  assigned during the term and final grades is described in the Academic Regulations of the
  University, Section 2.7, Informal Appeal of Grade and Section 2.8, Formal Appeal of Grade.

- **Academic Integrity**: Students should be aware of their obligations with regards to academic
  integrity. Please review the information about academic integrity at:
  https://carleton.ca/registrar/academic-integrity/ This site also contains a link to the complete
  Academic Integrity Policy that was approved by the University's Senate.

- **Academic Accommodations**: Requests for 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 obligation
    Please contact your instructor 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: carleton.ca/equity/wp-
  - Religious obligation
    Please contact your instructor 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: carleton.ca/equity/wp-
  - Academic Accommodations for Students with Disabilities
    If you have a documented disability requiring academic accommodations in this course,
    please contact the Paul Menton Centre for Students with Disabilities (PMC) at
    613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC
    coordinator to send your instructor your Letter of Accommodation at the beginning of the
    term. You must also contact the PMC 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 your instructor as soon as possible to ensure
    accommodation arrangements are made. carleton.caPMC
  - Survivors of Sexual Violence
    As a community, Carleton University is committed to maintaining a positive learning,
    working and living environment where sexual violence will not be tolerated, and is
    survivors are supported through academic accommodations as per Carleton's Sexual
    Violence Policy. For more information about the services available at the university and
    to obtain information about sexual violence and/or support, visit: carleton.ca/sexual-
    violence-support
  - Accommodation for Student Activities
    Carleton University recognizes the substantial benefits, both to the individual student
    and for the university, that result from a student participating in activities beyond the
    classroom experience. Reasonable accommodation must be provided to students who
    compete or perform at the national or international level. Please contact your instructor
    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. https://carleton.ca/
    senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

**Additional Information**
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.

Tentative Week-By-Week Schedule

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

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