Course Outline
Engineering 7824 – Discrete-Time Systems and Signals

Memorial University of Newfoundland
Faculty of Engineering and Applied Science

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1 Instructor

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E-mail is the easiest way to contact me. I can also be found in the CERL lab on the fourth floor. The sessional office will be used for office hours, but not much else.

2 Course Text

The official textbook for the course is the same as it was for the Term 4 signals course when most of you took it. Thus, most of you should already have it.

Official text:

However, if you do not already have this text, or have gotten rid of it, an alternate book which reads much better can be used. I will provide references in course notes for both texts.

Alternate text:

The official text should be available in the bookstore if you do not already have it. The alternate text can be ordered online without much trouble.
3 Course Web Site

A course web site will be maintained at http://www.engr.mun.ca/~ahouse/engi7824/. Up-to-date course notes and information, course schedules, relevant links, and other relevant information will be made available there.

4 Course Evaluation

<table>
<thead>
<tr>
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<th>Percentage</th>
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<tbody>
<tr>
<td>Assignments (5)</td>
<td>15%</td>
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<tr>
<td>Short Paper</td>
<td>5%</td>
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<tr>
<td>In-class Quizzes (2)</td>
<td>10%</td>
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<tr>
<td>Mid-term Exam</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>50%</td>
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4.1 Assignments

There will be five (5) assignments, each worth 3% of your term mark. This adds up to a significant portion of your overall mark.

Assignments may include problems from the text(s), problems involving lengthy workings, application problems, and problems that may require using Matlab or another programming language to solve them.

Assignments are individual effort – copying will not be tolerated.

It is expected that three (3) assignments will be issued before the mid-term exam. Due dates will be set with each assignment. Overall, the assignments should be roughly equally spaced throughout the term.

4.2 Short Paper

There will be a short research paper, worth 5% of your term mark, expected to be at least 1500 words long. That is roughly 3 pages of single-spaced text. Equations and figures are expected to be in addition to the 1500 words of text.

The paper will demonstrate your understanding of some aspect of discrete-time systems and signals. A list of suggested topics will be provided at a later date. You must logically explain the concept, and clearly present the main ideas, using examples where necessary. You should also use 3 to 5 references.

The paper will be due some time in July. Topics will be made available at least one month in advance of the due date. The papers will be marked on content, presentation, clarity, and structure. Grammar is a factor in marking, since it affects how your work is perceived.
4.3 In-Class Quizzes
There will be two (2) short in-class quizzes, one before the mid-term exam and one after, each worth 5% of your term mark. These quizzes take approximately 25 to 30 minutes of class time, and consist of objective questions or other short-answer questions.

4.4 Mid-Term Exam
The mid-term exam will take a full 75-minute class, and will cover material from the first 3 assignments and the first quiz. It is worth 20% of your term mark.

4.5 Final Exam
The final exam will be a standard exam, worth 50% of your term mark. It will cover the entire course, though the emphasis will likely be on the latter part of the course.

5 Course Structure
Lectures are scheduled for Tuesday and Thursday mornings from 9:00 to 10:15 AM in EN1040.

5.1 Tutorials
A tutorial slot is available, and will be used as needed. The tutorial will be used for example problems, answering questions from the class, going over assignment/test solutions, make-up lectures, or anything else as the need arises. Notice of the content of each tutorial class will be given in the preceding lecture.

5.2 Office Hours
Office hours will be held, most likely a day or two in advance of assignments being due. I am willing to work with the class to identify appropriate office hours. The office hours will be held in EN3026, the sessional instructor office.

5.3 Calculator Policy
For exams and quizzes, only non-graphing calculators without text storage capability may be used.

6 Course Overview
The content of the course is similar to previous years. The following is adapted or taken directly from last year’s course outline by Dr. Cecilia Moloney.
6.1 Course Objectives

1. To present the basic theoretical aspects of discrete-time signals and linear time-invariant systems.

2. To establish similarities and differences between the continuous-time and discrete-time theories of linear time-invariant systems.

3. To provide an introduction to the use of the discrete-time theory in digital signal processing.

6.2 Course Topic Outline

1. **Review**: Continuous-time signals and linear time-invariant systems.

2. **Sampling Theory**: Impulse train sampling; The sampling theorem; The effects of undersampling.

3. **Discrete-time Signals or Sequences**: Elementary sequences; Transformations; Using Matlab to represent and process discrete-time signals.

4. **Discrete-time Systems**: Linearity, time-invariance and other properties; Response to a discrete impulse; Response to any input - the convolution sum and its properties; Linear constant-coefficient difference equations as representation of discrete-time LTI systems; FIR vs IIR systems. Block diagrams.

5. **Fourier Analysis of Discrete-time Systems**: Response of a discrete-time LTI system to a complex discrete-time exponential; Discrete Fourier series as representations for periodic sequences; The discrete-time Fourier transform (DTFT) for aperiodic sequences and its properties; The discrete-time Fourier transform for periodic sequences; Frequency response of systems characterized by linear constant-coefficient difference equations; Relationships in frequency representations between continuous-time signals and their corresponding sampled discrete-time sequences.

6. **The z-Transform**: As extension of the DTFT and as counterpart to the Laplace transform; z-transform regions of convergence and other properties; Poles and zeros; Transfer functions of discrete-time systems.

7. **The Discrete Fourier Transform (DFT)**: Connections to other transforms; Properties and use in linear convolution; Applications; Fast algorithms to compute the DFT - the FFT. (As time permits.)

8. **Introduction to Digital Signal Processing (DSP)**: Current and emerging applications of discrete-time systems and signals in electrical and computer engineering; Digital processing of continuous-time signals; Software and hardware implementations of DSP systems; Study of one or two pertinent applications of DSP using the course material.