Signal Processing

Department of Electronic Engineering
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Syllabus Outline

- **Foundations of Signal Processing**
  Signal Processing Overview, Analog Signal Analysis, Discrete-Time Signals and Systems, Sampling and Reconstruction of Analog Signals

- **Discrete-Time Signal Analysis Tools**
  z-Transform, Discrete-Time Fourier Transform (DTFT), Discrete Fourier Series (DFS), Discrete Fourier Transform (DFT)

- **Digital Filters**
  Response, Realization and Design of Finite Impulse Response (FIR) Filters and Infinite Impulse Response (IIR) Filters

- **Application Case Studies**
  Telephone Touch-tone Generation and Decoding, Interference Cancellation
Intended Learning Outcomes

On completion of this course, you will be able to

- Recognize properties of continuous-time and discrete-time signals and systems such as stability, causality, linearity and time-invariance

- Explain the relationship among different signal processing transforms

- Analyse discrete-time systems and calculate system parameters using appropriate transforms

- Design and realize digital filters according to predefined specifications such as filter shapes and cutoff frequency

- Develop signal processing techniques for engineering problems
# Teaching Pattern

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<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
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<tbody>
<tr>
<td>5 Sep.</td>
<td>Lecture 1</td>
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<td>12 Sep.</td>
<td>Lecture 2</td>
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<td>19 Sep.</td>
<td>Lecture 3</td>
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<td>26 Sep.</td>
<td>Lecture 4</td>
<td>MATLAB Exercise 1 Due</td>
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<td>3 Oct.</td>
<td>Lecture 5</td>
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<td>10 Oct.</td>
<td>Lecture 6</td>
<td>Assignment 1 Due</td>
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<td>17 Oct.</td>
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<td>Chung Yeung Festival</td>
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<td>24 Oct.</td>
<td>Lecture 7</td>
<td>Test 1</td>
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<td>31 Oct.</td>
<td>Lecture 8</td>
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<td>7 Nov.</td>
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<td>14 Nov.</td>
<td>Lecture 10</td>
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<td>21 Nov.</td>
<td>Lecture 11</td>
<td>Test 2</td>
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<td>28 Nov.</td>
<td>Lecture 12</td>
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Assessment

Coursework: 40%
- 2 Assignments: 10%
- 2 MATLAB Exercises: 10%
- 2 Tests: 20%

Examination: 60%

To pass the course, at least 30% of coursework AND examination marks are required. All tests and examination are open book format.

Act of academic dishonesty (e.g., plagiarism, submission for assessment of material that is not your own work) will be liable to disciplinary actions.
Book List

Textbook:

References:
MATLAB Resources


http://www-h.eng.cam.ac.uk/help/tpl/programs/matlab.html


Precursors/Prerequisites

Basic knowledge in linear algebra, complex number, differentiation and integration, e.g.,

For a complex number \( a + jb \), \( j = \sqrt{-1} \), its magnitude and phase are \( |a + jb| = \sqrt{a^2 + b^2} \) and \( \angle(a + jb) = \tan^{-1}(b/a) \)

Euler formulas: 
\[
\cos(x) = \frac{e^{jx} + e^{-jx}}{2}, \quad \sin(x) = \frac{e^{jx} - e^{-jx}}{2j}
\]

\[
\frac{d(3x^n + 2x + 1)}{dx} = n \times 3x^{n-1} + 2x^{1-1} = 3nx^{n-1} + 2
\]

\[
\int_{-T}^{T} e^{-jkt} dt = -\frac{1}{jk} e^{-jkt} \bigg|_{-T}^{T} = -\frac{e^{-jkT} - e^{jkT}}{jk} = \frac{2\sin(kT)}{k}
\]