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>LT-11 AC1</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>
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<td>17 Oct.</td>
<td>Lecture 7 at LT-2</td>
<td>Test 1</td>
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<td>24 Oct.</td>
<td>Lecture 8</td>
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<td>31 Oct.</td>
<td>Lecture 9</td>
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<td>14 Nov.</td>
<td>Lecture 11</td>
<td>Assignment 2 Due</td>
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<td>21 Nov.</td>
<td>Lecture 12 at LT-2</td>
<td>Test 2</td>
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<td>28 Nov.</td>
<td>Lecture 13</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 35% 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:

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

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

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