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>
<th>Remark</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>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>10 Oct.</td>
<td>Lecture 6</td>
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<td>17 Oct.</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>Assignment 2 Due</td>
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<td>21 Nov.</td>
<td>Lecture 12</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: \( \cos(x) = \frac{e^{jx} + e^{-jx}}{2}, \ \sin(x) = \frac{e^{jx} - e^{-jx}}{2j} \)

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

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