Introduction to Discrete Time Signals & Systems

ECE 2050

Course Description:
Introduction to sampled time signals and linear time invariant sampled time systems.

Course Goals / Objectives:
Be competent with the fundamentals of discrete time linear time invariant (LTI) systems
Be competent in using laboratory instruments, methodology and reporting standards
Be competent in working in teams for laboratory experiments
Be competent in performing z-transforms and inverse z-transforms
Be competent in analyzing, designing and synthesizing discrete time LTI systems, including finite impulse response (FIR) and infinite impulse response (IIR) filters
Be familiar with sampling, analog to digital and digital to analog conversions
Be familiar with how to implement designs in hardware using modern techniques such as FPGAs and microcontrollers
Be exposed to troubleshooting and debugging practices
**Course Topics:**

- Introduction to continuous & discrete signals, sampling & aliasing, quantization
- Review of complex numbers
- Discrete time signals and special functions
- Discrete time systems descriptions & properties: LTI systems, impulse response, FIR/IIR conditions, convolution, difference equations, zero-state and zero-input, flow diagrams
- Z-transform techniques: two-sided vs one-sided z-transform, region of convergence (ROC), rational z-transforms, LTI systems in z-domain, power series and partial fraction expansion, transient and steady-state, stability
- Steady-state frequency response of discrete time LTI systems: spectrum, Fourier series, discrete time Fourier transform & relationship to z-transform, frequency response from poles & zeros in transfer function
- Frequency response of LTI systems and LTI frequency selective filters
- Instrumentation and CAD tool review: oscilloscope, Matlab, and microcontroller programming.
- Microcontroller-based implementation of discrete time filters (FIR, IIR)

**Grades Breakdown:**

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<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Midterm Exam 1</td>
<td>20%</td>
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<tr>
<td>Midterm Exam 2</td>
<td>20%</td>
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<tr>
<td>Lab Reports</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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**Designation:**

Required
Instruction Modes:
In Person (75-100% campus; 0-24% online)
Hybrid Class (25-74% campus; 25-74% online)

Representative Textbooks and Other Course Materials:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
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<tbody>
<tr>
<td>Digital Signal Processing, any edition</td>
<td>John G. Proakis &amp; Dimitris G.</td>
<td></td>
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<tr>
<td>(recommended)</td>
<td>Manolakis</td>
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