EEO303 Digital Signal Processing

Bulletin Course Description
Covers the general area of discrete-time signals and the analysis and design of discrete time systems. Topics include time domain analysis, solutions of difference equations, Z-transform analysis, sampling of continuous-time signals, discrete Fourier transforms, Fast Fourier Transforms, and spectral analysis. Processing of discrete-time signals using the DFT and FFT. Design and implementation of discrete-time filters. Extensive use of software simulations in Matlab. Final Matlab-based project required.

Prerequisites: EEO 301. The course assumes a basic understanding of Signals & Systems.

Instructor and Office Hours
Instructor: Mark Fowler
Email: m Fowler@binghamton.edu  (Don’t use my Stony Brook email!!!)
Office Location: N/A for online course
Office Phone: N/A
Office Hours: TBD…. Email me any questions or issues
Location: N/A for online course
Time: TBD

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LEARNING OBJECTIVES
At the end of this course, students will:

1. Apply the z-transform to analyze linear, time-invariant discrete-time systems
2. Apply the discrete-time Fourier transform to analyze discrete-time signals
3. Apply the discrete-time Fourier transform to analyze linear, time-invariant discrete-time systems
4. Apply the theory of sampling to analyze schemes for sampling continuous-time signals
5. Apply the discrete Fourier transform (DFT) to numerically analyze discrete-time signals
6. Understand the operation of fast Fourier transform (FFT) algorithms
7. Apply FFT algorithms for efficient linear filtering implementation
8. Apply FFT algorithms for spectral analysis of discrete-time signals
9. Design discrete-time filters to meet specifications
10. Implement discrete-time filters using practical methods
11. Use MATLAB to simulate discrete-time signals, systems, and processing.

COURSE REQUIREMENTS

Proctor Policy
As this is an online course, all exams must be proctored by an acceptable proctor. A librarian, member of the HR/Training staff within your company, former professors, supervisor/manager, superior officers if you are in the military, member of the clergy, or a member of a learning or testing center could qualify to serve as your proctor. Public libraries will normally proctor examinations; however, there is sometimes a nominal charge for this service.

Textbook and Reading

Topics and semester schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>Week 1, Lecture 1</td>
<td>Review of Basic Signals &amp; Systems</td>
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<tr>
<td>Week 1, Lecture 2</td>
<td>Review of Basic Signals &amp; Systems</td>
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<tr>
<td>Week 2, Lecture 1</td>
<td>Definition and mathematical properties of Z Transform (ZT)</td>
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<tr>
<td>Week 2, Lec 2</td>
<td>Using ZT to analyze discrete-time systems</td>
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<tr>
<td>Week 3, lec 1</td>
<td>Mathematical properties of the DTFT</td>
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<tr>
<td>Week 3, Lecture 2</td>
<td>Using DTFT to analyze DT signals</td>
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<tr>
<td>Week 4 Lecture 1</td>
<td>Using the DTFT to analyze DT systems</td>
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<tr>
<td>Week 4, Lec 2</td>
<td>Using the DTFT to characterize DT filters</td>
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<tr>
<td>Week 5, Lec 1</td>
<td>Sampling Theory &amp; Practical Sampling and Reconstruction</td>
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<tr>
<td>Week 5, Lec 2</td>
<td>Bandpass Signals</td>
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<tr>
<td>Week 6, Lec 1</td>
<td>Bandpass Sampling &amp; Oversampling</td>
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<tr>
<td>Week 6, Lec 2</td>
<td>Midterm Exam #1</td>
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<tr>
<td>Week 7 Lecture 1</td>
<td>Introduction to Matlab for Signal Processing</td>
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<tr>
<td>Week 7, Lec 2</td>
<td>Mathematical Details of DFT</td>
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<tr>
<td>Week 8, Lec 1</td>
<td>Using DFT to Implement FIR Filters</td>
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<tr>
<td>Week 8, Lec 2</td>
<td>Using DFT for Spectral Analysis</td>
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</tbody>
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| Week 9 Lecture 1| 1. DFT with windows  
2. Spectral Analysis in presence of noise |
<p>| Week 9 Lecture 2| FFT Algorithm – Radix 2 Decimate-in-Time |
| Week 10 Lecture 1| Alternative FFT Algorithms |
| Week 10 Lecture 2| Midterm Exam #2 |
| Week 11 Lecture 1| Design of FIR Filters, Part I |
| Week 11 Lecture 2| Design of FIR Filters, Part II |
| Week 12 Lecture 1| Design of IIR Filters, Part I |
| Week 12 Lecture 2| Design of IIR Filters, Part II |
| Week 13 Lecture 1| Implementation Structures for FIR Filters |</p>
<table>
<thead>
<tr>
<th>Week 13 Lecture 2</th>
<th>Implementation Structures for IIR Filters</th>
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<tbody>
<tr>
<td>Week 14 Lecture 1</td>
<td>Representation of Numbers</td>
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<tr>
<td>Week 14 Lecture 2</td>
<td>Quantization of Filter Coefficients</td>
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<tr>
<td>Week 15</td>
<td>Round-off Effects in Digital Filters</td>
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**Grading**

Your grade will be based on attendance, paper reviews (written and oral), programming assignments, a midterm exam, and the final project.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Midterm Exam #1</td>
<td>25%</td>
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<tr>
<td>Midterm Exam #2</td>
<td>25%</td>
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<tr>
<td>Final Exam</td>
<td>35%</td>
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**Honor Policy**

- All exams, homework, and project assignments are subject to this Honor policy. This means that placing your name on an exam or an assignment implicitly pledges that you abided by the terms of this policy.
- The homework assignments, exams, and projects are to be done alone. Any malpractice (e.g., reporting fraudulent data, copying another student’s solution, plagiarism) will be treated as an Honor Code violation.

Any suspected instance of academic dishonesty will be reported to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at [http://www.stonybrook.edu/uaa/academicjudiciary/](http://www.stonybrook.edu/uaa/academicjudiciary/)