EE 534 - Digital Signal Processing - 3 hours
Elective Course

1. *2007-2008 Catalog description*
   Representation and analysis of discrete time signals and systems. Finite and infinite impulse response filter design;
   computer-aided-design; Fast Fourier Transform; implementation of digital filters.
   Prerequisite: EE 302.

2. *Prerequisites by topic*
   a System representation
   b Transfer functions
   c Impulse response
   d Frequency response
   e Random processes

3. *Textbook (s) and/or other required material*
   Required: "Digital Signal Processing," by John G. Proakis and Dimitris G. Manolakis, Fourth Edition, 2007, Pearson
   Prentice-Hall.

4. *Class/Laboratory Schedule*
   Three class sessions per week, each 50 minutes, for 14 weeks

5. *Topics Covered (Outcomes influenced)*

- Sampling , convolution, difference equation, block diagrams (7a, 7b)
- Z-transform, discrete Fourier transform, spectral analysis (7b, 7c)
- Discrete time frequency response, poles and zeros, graphical frequency response (7b, 7c)
- Infinite impulse filter design, bilinear transform, impulse invariant, optimal techniques (7f, 7g, 7j)
- Finite impulse response design, windows, frequency sampling, optimal techniques (7g)
- The fast Fourier transform, decimation in time and decimation in frequency algorithms (7h, 7j)
- Frequency domain signal processing using the FFT (7h, 7j)
- Multirate signal processing and applications to filtering, sub-band coding, and filter banks (7i, 7j)
- Issues in the construction of digital filters, coefficient sensitivity, round-off noise, sampling and multi-rate filter structures (7i)
  - Grading Policy and ECE Code of Conduct (7k)

6. *Contribution of course to meeting the curriculum components*
   Engineering Science - 50%, Engineering Design - 50%

7. *Course Outcomes (Program Outcome contributions): In learning the course topics, the student will attain the following outcomes*
   a The student will describe discrete time signals generated by continuous time sampling (9A)
   b The student will analyze describe discrete time systems using difference equations, the impulse response, the transfer function in the Z domain, the frequency response function, a pole-zero description (9A)
   c The student will apply the Z transform to solve for the steady-state and transient response (9A, 9B)
   d The student will apply the discrete Fourier transform (DFT) to analyze discrete time systems and signals (9A, 9B)
   e The student will understand and be able to apply DFT theorems for modulation, differentiation, delay, Parseval's and power and energy density spectrums (9B)
   f The student will design finite (FIR) and infinite impulse response (IIR) digital filters using pole-zero placement, the transform method and by transforming analog filters using the bilinear transform (9B, 9C)

g The student will apply optimal filter design approaches for FIR and IIR design (9B)
h The student will derive the decimation in time (DIT) and decimation in frequency (DIF) algorithms for computing the DFT, and apply to signal processing applications (9B, 9C)
i The student will describe and analyze multirate systems (9B, 9C)
j The student will use Matlab tools including Simulink for the analysis of discrete-time signals and the analysis and design of discrete-time systems (9B, 9C, 9F)
k The student will understand the ECE Code of Conduct (9G)

8. *Grading policy and criteria*

There will be four exams worth seventy-five points each and a final worth one hundred and fifty points. Special homework assignments involving simulation will be collected and will count up to fifty points in determining the final grade. An estimate of the letter grade for every two exams will be given when the exam is returned; however, the final grade will be determined by the combined numerical results of all tests. All exams will be closed book. No notes, calculators, or cell phones will be permitted. Exams may include Matlab examples for interpretation. A grade of C corresponds to meeting the minimum competency required to understand course topics and meet course objectives. Final grades will be determined by different criteria for graduate and undergraduate students. Graduate students will be expected to perform at a higher level than undergraduate students. Warning**:** An unexcused absence from a scheduled exam will earn you a zero for that exam. In addition, cheating will be dealt with as described in the *Academic Handbook.* The ECE Faculty has established the ECE Student Code of Conduct based on well known requirements of academic integrity as well as the ethical and professional conduct expected of an engineer. The ECE student code is attached to this document and also appears on Blackboard.

9. *Relationship of course to program outcomes*

label	Program Outcomes (A Graduate from the program will:)	Contribution
A	have knowledge of the mathematical and scientific foundation of electrical engineering	Strong
B	have knowledge of and the ability to apply techniques and technology of electrical engineering	Strong
C	complete a design project sequence, culminating in a capstone project at or near the professional level	Foundational
D	understand that acquisition of new knowledge is needed for success in the electrical engineering profession	Moderate
E	meet Bradley's general education requirements which are based on the principles of liberal education	NA
F	have experience in communicating technical information and working on teams	Foundational
G	understand the importance of professional and ethical behavior	Moderate

10. *Prepared by*: Thomas L. Stewart, July 25, 2008.