

## ELEG 3133 - DIGITAL SIGNAL PROCESSING

Spring, 1999

Catalog Data: ELEG 3133. Digital Signal Processing. Credit 3. Time domain and frequency domain analysis and design of digital systems. Topics include: Discrete Fourier Transform, Fast Fourier Transform, z-Transform, Sampling, A/D and D/A Conversion, Digital Filter Design. Prerequisite: ELEG 3123, Corequisite: ELEG 3131L.

Text Book: Signal Processing and Linear Systems, B. P. Lathi, Berkley-Cambridge, 1998.

Reference: MATLAB Reference Guide, Mathworks, 1995.

Coordinator: N. M. Schmitt, University Professor of Electrical Engineering.

Goals: The student should be able to:

- Convert any continuous time deterministic signal to a discrete time signal through the sampling process and recover the analog signal using D/A methods
- Perform complete time domain and frequency domain analysis of LTID systems with deterministic inputs
- Find the z-transform and inverse z-transform of signals
- Design discrete FIR and IIR filters to meet performance criteria.
- Calculate the DFT using the FFT

Prerequisites by Topic:

1. Classical solutions of LTI differential equations
2. Evaluation of convolution integrals and summations
3. The use of Laplace transforms in the solutions of LTI system problems
4. MATLAB
5. Analog Filter Design

Topics:

1. Sampling and Re-construction (6 classes)
  - The sampling theorem
  - Conversion of analog signals to discrete signals
  - Quantization and coding
  - Quantization error and choosing A/D Converter bit size
  - Computation and the DFT and introduction to the FFT
2. Discrete-time signals and discrete time systems (4 classes)
  - Discrete-time signal models
  - Sampling sinusoids and aliasing
  - Signal operations
  - DT system block diagrams/ DT equation relations
3. Complete analysis of discrete-time systems in the time domain (6 classes)
  - Calculating the zero input response
  - Finding the impulse response
  - Finding the zero-state response and the complete response
4. Discrete Fourier transform and FFT (6 classes)
  - Properties of the DTFT
  - DTFT and DFT relationship
  - Signal Processing using the DFT
  - The FFT
5. Z-transform (3 classes)

- Definition and properties
- Finding the ZT and the Inverse ZT
- 6. Complete Analysis of discrete-time systems in the frequency domain (3 classes)
- 7. System Design using pole-zero locations (2 classes)
- 8. Recursive Filter Design (3 classes)
  - Design Criteria
  - Impulse Invariance Method
  - Bilinear Transformation Method – prewarping
- 9. Non-Recursive Filter Design (4 classes)
  - Windowing
  - Window types
  - Computerized Procedures
- 10. Exams (5 classes)

Computer Usage:

Various homework assignments using MATLAB.

Laboratory Projects:

See ELEG 3131L.

ABET Category content as estimated by faculty member who prepared this description:

Engineering Science: 1.5 credits or 50%.

Engineering Design: 1.5 credits or 50%.

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_