Course Title: Digital Signal Processing
Course Code: ETEG 305
Credit Hours: 3

Course Description:
This course intends to introduce digital signal processing techniques and applications.

Course Contents:

Unit 1: Review of Signal and Systems course Regarding Discrete-Time Signals and Systems

Unit 2: Z-Transform
Definition of the z-transform, Relation between the Z-transform and the Fourier transform of a sequence, Properties: linearity, Shifting, convolution, Scaling, Multiplication by K Vector sequences; Inverse z-transform: Direct division, Partial fraction expansions, the inverse integral; System response, Transfer function $H(z)$, Transient and steady state sinusoidal response - pole-zero relationships, Stability

Unit 3: Discrete Filters
Filter structures, Second order sections, Ladder and wave filters; Frequency response; Sampling continuous signals, Spectral properties of continuous signals, Aliasing, Anti-aliasing signals and reconstruction analog filters; Effects of sample and hold at filter input and output; Digital filters, Finite precision implementations of discrete filters; Scaling & noise in digital filters, Quantized signals, quantization error, Linear models

Unit 4 : Finite Duration Impulse Response (FIR) Digital Filters
FIR filter design by Fourier approximation, The complex Fourier series, Gibbs phenomena in FIR filter Design approximations, Applications of window functions to frequency response smoothing; Window functions, Rectangular, Hanning, Hamming and Kaiser windows; FIR filter design by the frequency sampling method; FIR filter design using the Remez exchange algorithm; Linear phase FIR filters, Unit sample response symmetry, Group delay

Unit 5 : Infinite Impulse Response (IIR) Digital Filters
Classical filter design using polynomial approximations, Butterworth, Chebychev, Elliptic and Bessel forms, IIR filter design by transformation-matched Z-transform, Impulse-invariant transform and bilinear transformation, Application of the bilinear transformation to IIR lowpass discrete filter design, Spectral transformation, Highpass, Bandpass and notch filters

Unit 6: The Discrete Fourier Transform
The discrete Fourier transform (DFT) derivation, Properties of the DFT, DFT of non-periodic data, Use of window functions

Unit 7: Introduction of the Fast Fourier Transform (FFT)
FFT computation methods, Spectral analysis and convolution using FFT, Power spectral density using DFT/FFT algorithms

Unit 8: Applications of Digital Signal Processing and Introduction to Digital Signal Processors

References:

1. A. V. Oppenheim, *Discrete-Time Signal Processing*, Prentice Hall 1990
2. L. R. Rabiner & B. Gold, *Theory and Application of Digital Signal Processing*, Prentice Hall 1993
3. J. R. Johnson, *Introduction to Digital Signal Processing*, Prentice Hall
4. R. A. Robert, *Digital Signal Processing*, Addison Wesley