

## ECE303: DIGITAL SIGNAL PROCESSING

L:2 T:0 P:2 Credits:3

**Course Outcomes:** Through this course students should be able to

- CO1 :: illustrate discrete time signals and systems in time domain
- CO2 :: analyze signals and systems in transformed domain
- CO3 :: develop digital filters using various techniques
- CO4 :: examine digital filter implementation structures and concerns
- CO5 :: illustrate word length issues in FIR and IIR filters
- CO6 :: simulate real life applications using digital signal processing algorithms

### Unit I

**Review on discrete-time signals and systems** : signal operations, classification of signals, introduction to systems, classification of systems – linearity, time-invariance, stability, linear convolution

### Unit II

**Fourier analysis using DFT and FFT** : z-transform and inverse z-transform, frequency analysis, DFT and IDFT, DFT properties, linear convolution using DFT and IDFT, computation of DFT and IDFT using FFT algorithm

### Unit III

**Design of FIR filters** : FIR filters design using rectangular window, hamming window, hanning window, blackman window, linear phase response, pole-zero plot of FIR filter

### Unit IV

**Design of IIR filters** : impulse invariant transformation, bilinear transformation, introduction to butterworth analog filters, designing of low-pass, high-pass, band-pass and band-stop butterworth filter, introduction to chebyshev analog filters, designing of low-pass, high pass, band-pass and band-stop chebyshev filter

### Unit V

**Filter realization and finite word length effects** : direct form-I and form-II realization, cascade and parallel form realization, introduction to finite word length effects: quantization noise, input quantization error, coefficient quantization error, overflow and limit cycles

### Unit VI

**Applications of signal processing** : biomedical signal processing-ECG and EEG, digital image processing- image enhancement and segmentation, image restoration, digital communication- mobile phone signal processing and RADAR with their block diagrams, echo and chorus (reverberation) generation, music synthesis system

### List of Practicals / Experiments:

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- elementary signals in Octave
- linear convolution
- visualisation of simulated signals using FFT
- system representation using FFT
- frequency representation of real world signals
- design of FIR filters using various windows
- filtering using FIR filter
- design of IIR butterworth filter
- design of IIR chebyshev filter
- filtering using IIR filter

- filter transformation
- ECG data acquisition and filtering
- image operations
- echo generation
- image enhancement and restoration

**Text Books:**

1. DIGITAL SIGNAL PROCESSING PRINCIPLES, ALGORITHMS AND APPLICATIONS by JOHN G PROAKIS, DIMTRIS G MANOLAKIS, PEARSON

**References:**

1. DIGITAL SIGNAL PROCESSING by S. SALIVAHAN, A VALLAVARAJ, GNANPIYA, MC GRAW HILL
2. DIGITAL SIGNAL PROCESSING-A COMPUTER BASED APPROACH by S. K. MITRA, MC GRAW HILL
3. DIGITAL SIGNAL PROCESSING by A.ANAND KUMAR, PHI Learning Pvt Ltd
4. DIGITAL SIGNAL PROCESSING - A MODERN INTRODUCTION by ASHOK AMBARDAR, CENGAGE LEARNING