IT-502: Digital Signal Processing [40 lectures]:

***Learning Objective**: This course will enable the students to enhance their analytical ability in facing the challenges posed by growing trends in communication, control and signal processing areas. It will develop the ability for problem formulation, system design and solving skills through the basic knowledge of Digital Signal Processing and understanding various transformations. Many discrete-time signals classes, shift-invariant systems, convolution, frequency domain transformations, etc will be covered. At the end of this course the students will be well trained to design systems with digital networks using adders, delay elements, coefficient multipliers, etc.*

Introduction to Discrete–time Signals and Systems [10 lectures]

- Classification of Discrete time signals and sequences --- Linear time-invariant (LTI) systems, (BIBO) stability, and causality; linear convolution in time domain; graphical approach [5 lectures]
- The concept of z-Transforms --- Region of convergence; properties; inverse z-transform; realization of digital filter structures (direct forms I and II, transposed form, cascaded form, parallel form) [5 lectures]

Discrete-time Signals in Transform Domain [12 lectures]

- Discrete Fourier Series (DFS) and Discrete-time Fourier Transforms (DTFT) [4 lectures]
- Discrete Fourier Transform (DFT) --- Properties of DFT, linear convolution using DFT; circular convolution; fast Fourier transforms (FFT); radix-2 decimation in time and decimation in frequency; FFT algorithms; inverse FFT [8 lectures]

Digital Filters [18 lectures]

- Infinite Impulse-response (IIR) filters ---analog filter approximations (Butterworth and Chebyshev); impulse invariant transformation; bilinear transformation; design of IIR filters from analog filters [8 lectures]
- Finite Impulse-response (FIR) Filters ---Characteristics of FIR filters; frequency response; design of FIR filters using window techniques; comparison of IIR and FIR filters [8 lectures]
- Multi-rate Processing --- Decimation; interpolation; sampling-rate conversion; implementation of sampling rate conversion [2 lectures]

References

1. **Sanjit K. Mitra**, Digital Signal Processing, 2nd Edition, TATA McGraw Hill
2. **John G. Proakis and Dimitris G. Manolakis**, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education/PHI, 2007
3. **Alan V. Oppenheim and Ronald W. Schafer**, Digital Signal Processing, PHI Ed., 2006
4. **Andreas Antoniou**, Digital Signal Processing, TATA McGraw Hill , 2006
5. **MH Hayes**, Digital Signal Processing, Schaum's Outlines, TATA Mc-Graw Hill, 2007