Course Syllabi: UEI503 Digital Signal Processing and Applications (L : T : P :: 3 : 1 : 0)

1. **Course number and name:** UEI503; Digital Signal Processing and Applications

2. **Credits and contact hours:** Credits: 3.5; Hours: 4

3. **Text book, title, author, and year**

   - *Helmut, U. and Willibald, W., Protection Techniques in Electrical Engg. Systems, Marcel Dekker Inc. (2001).*
   - *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice-Hall of India Private Limited (1996).*
   - *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing, Prentice-Hall of India Private Limited (2000).*
   - *Antonion, A., Digital Filters: Analysis Design and Application, Prentice-Hall of India Private Limited (1999).*
     Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice-Hall of India Private Limited (1998).

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Representations of discrete signals and systems and basic operators, z-Transforms, Causality and Stability in terms of z-transform, Bilateral z-transform, Computation of z-transform.
   Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Discrete Fourier Series, Discrete Fourier Transform and its Properties, Efficient Computation of DFT using FFT algorithms, Linear Filtering Approach to Computation of DFT.
   Digital Filter Structure: Describing Equation, Structures for FIR Systems and Structure for IIR Systems, Representation of Structures using Signal Flow Graph.
   Design of Digital Filters: Introduction, Difference between analog filters and digital filters, Implementation of digital filter, Types of filters, LTI systems as filters, Design of IIR filters from analog filters, IIR filter design using Butterworth Approximation, Frequency transformation, FIR filters design, Least square filter design, Designing digital filter from pole-zero placement, Butterworth filter design using Bilinear transformation, FIR filter design using windows, Design of filters using pole-zero combination.
   Hardware Architecture of DSP Processor: Introduction, Desirable features of DSP processors, Types of architectures, Internal architecture of ADSP-21xx family, Features of ADSP-21xx family processors, System interface, Instruction set of ADSP-21xx, ADSP-21xx Development tools, ADSP-210x Processors, TMS DSP processor,.
   Analysis of Finite Word-length Effects: Introduction, the quantization process and errors, Analysis of coefficient quantization effects in FIR filters, A/D conversion noise analysis, Analysis of arithmetic roundoff errors, Dynamic range scaling, Low sensitivity digital filters, Reduction of product round off errors, Limit cycles in IIR filters, Round off errors in FFT algorithms.
   Applications: Dual-tone multi frequency signal detection, Spectral analysis using DFT, Short term DFT, Musical sound processing, oversampling A/D converter, Oversampling D/A converter, Protection.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:

   - Express discrete-time signals analytically and visualize them in the time and frequency domain.
   - Design and implementation digital filters.
   - Illustrate the architecture and use of digital signal processors.
   - Apply DSP techniques in different fields.

6. **Brief list of topics to be covered**

   - DFT and FFT
   - Digital Filter Structure
   - Design of Digital Filters
   - Hardware Architecture of DSP Processor
   - Analysis of Finite Word-length Effects