Course Name	Digital Signal Processing
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Course Code	EC(EE)601A
Course Credit	2
Contact Hour	2L-1T
Prerequisite	

Course Objective

The objectives of this course are

1. Understand basic tradeoffs in digital representation of signals: sampling rate, bandwidth, bit rate, fidelity
2. Analyse minimum phase, linear phase, and all-pass discrete-time systems
3. Check the stability of filters
4. Choose filter structures according to their performance characteristics: sensitivity, complexity, delay, etc
5. Program digital signal processors to perform DSP in real-time
6. Analyse and design filters based on pole/zero placement.
7. Design linear phase FIR filters using windows and equipripple technique
8. Design IIR filters from continuous-time filters
9. Design filters using Matlab and exploit more sophisticated design tools in Matlab
10. Analyse signal spectra using DFT/FFT
11. Apply FFT to filtering applications

Course Outcome

On completion of the course students will be able to

1. Demonstrate the concept of Conductors, Insulators, and Semiconductors based on energy-band theory and analyze relevant problems
2. Explain the working principles of P-N Junction Diode, zener diode and analyze their applications in the rectifier, clipper, clamper, regulator etc.
3. Analyze characteristics of Bipolar junction transistor(BJT) under CE, CE, CC mode of operation and its biasing therein
4. Distinguish the operations of JFET, MOSFET and demonstrate their operations under CG, CS, CD configurations
5. Determine parameters in Operational Amplifier circuit design for various applications

CO Mapping with departmental POs

H: High, M: Medium, L: Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	H	H	M		L		H		M			H
CO 2	H	H	M		L	M		M				H
CO 3	H	H	H	L		H	M					H
CO 4	H	H	H		M			L		L		H
CO 5	H	H		M		M		L				H

Course Content

Module I   10L

Discrete-time signals: Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp & complex exponentials, arithmetic operations on sequences.

LTI systems: Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non recursive systems.

Module II   15L

Discrete Time Fourier Transform(DTFT): Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

Z- Transforms: Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Perseval's relation, inverse Z transform by contour integration, power series & partial-fraction expansions with examples and exercises.

Discrete Fourier Transform: Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences- Overlap-Save and Overlap-Add methods with examples and exercises.

Fast Fourier Transforms: Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module III   7L

Filter design: Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization.

Module IV   8L

Digital Signal Processor: Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in assembly Language.

FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.

Numerical problems to be solved

Text Books:

1. Digital Signal Processing-A computer based approach, S. Mitra, TMH
2. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis & M.G. Manslakis, PHI
3. Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.
4. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Leasrning

Reference Books:

1. Digital Signal Processing, Chen, OUP
2. Digital Signal Processing, Johnson, PHI
3. Digital Signal Processing using MATLAB, Ingle, Vikas.
4. Digital Signal Processing, Ifeachor, Pearson Education.
5. Digital Signal Processing, A.V. Oppenhein & R.W. Shaffer, PHI
6. Theory and application of Digital Signal Processing, L.R. Rabiner & B. Gold, PHI
7. Digital Signal Processing, Ashok Ambarder, Cengage Learning.
8. Digital Signal Processing, S. Salivahanan, A. Vallavaris & C. Gnanpruja, TMH.
9. Xilinx FPGA user manual and application notes.