Digital Signal Processing (PCET5020T)

Teaching Scheme
Lectures: 03 Hrs./Week
Credit: 03

Examination Scheme
Term Test: 15 Marks
Teacher Assessment: 20 Marks
End Sem Exam: 65 Marks
Total: 100 Marks

Course Objectives

1. To develop a thorough understanding of DFT and FFT and their applications.
2. To teach the design techniques and performance analysis of digital filters.
3. To introduce the students to digital signal processors and its applications.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply the efficient computing algorithms of DFT and FFT in finding the response of the system.	L2	Comprehension
CO2	Design different types of IIR filters.	L4	Analyze
CO3	Design different types of FIR filters.	L4, L5	Analyze, Synthesize
CO4	Evaluate the effects of Poles and Zeros in design of digital filters.	L6	Evaluate
CO5	Understand the architecture of DSP Processors.	L6	Evaluate
CO6	Explain the applications of Digital Signal Processing in different areas of Telecommunication.	L6	Evaluate

Course Contents

Unit-I Discrete Fourier Transform & Fast Fourier Transform 10 Hrs.

Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, composite Radix FFT N=2.3, N=3.2.

Unit-II IIR Digital Filters 10 Hrs.

Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop), Analog filter approximations: Butterworth, Chebyshev I. Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with numerical examples. Effect of Poles and Zeros on the Frequency Response of IIR filters. Position of Poles and Zeros of Low Pass, High Pass, Band Pass, Band Stop, All Pass filters.

Unit-III FIR Digital Filters 08 Hrs.

Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase (Type 1 to Type 4) FIR Filters. Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackman, Kaiser), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.

Unit-IV Poles, Zeros and Filters 06 Hrs.

Effects of poles and zeros in the frequency response of IIR filters (LP, HP, BP, BR/Notch, All Pass filters). Placement of zeros and design of filters in Type1 to Type 4 Linear Phase FIR filters. Finite Word Length effects in Digital Filters Quantization, truncation and rounding, Error due to truncation and rounding.

Unit-V DSP Processors 04 Hrs.

Introduction to General Purpose and Special Purpose DSP processors, fixed point and floatingpoint DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC), Special Instructions,Special purpose DSP hardware, Architecture of TMS320CX fixed and floating DSP processors.

Unit-VI Applications of Digital Signal Processing 04 Hrs.

Application of DSP for ECG signals analysis. Application of DSP for Dual Tone Multi Frequency signal detection. Application of DSP for Radar Signal Processing.

Text Books

1. Proakis J., Manolakis D., Digital Signal Processing, 4^{st} Edition, Pearson Education.
2. Oppenheim A., Schafer R., Buck J., Discrete Time Signal Processing, 2^{st} Edition, Pearson Education.
3. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata McGraw Hill, 2004.

Reference Books

1. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital Signal Processing, A Practical Approach by, Pearson Education.
2. Sanjit K. Mitra, Digital Signal Processing A Computer Based Approach, 4th Edition McGraw Hill Education (India) Private Limited.
3. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, 2015.

Evaluation Scheme:

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 15 marks each will be conducted during the semester.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper will be based on the entire syllabus summing up to 65 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Digital Signal Processing Laboratory (PCET5020L)

Teaching Scheme
Practical: 02 Hrs/Week
Credit: 01

Examination Scheme
Teacher Assessment: 25 Marks
End Sem Exam : 25 Marks
Total: 50 Marks

Course Objectives

1. To apply DFT and FFT algorithms to solve real world applications.
2. To implement the design techniques of digital filters.

COs	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement DFT and FFT algorithms in finding the response of the system.	L4, L6	Analyze, Evaluate
CO2	Design different types of IIR filters.	L5	Synthesize
CO3	Design different types of FIR filters.	L2	Understand
CO4	Determine effects of Poles and Zeros in the frequency response of digital filters.	L2	Understand

Course Contents

List of Laboratory Experiments: (Any Eight)

1. Plot of Discrete Time Signals.
2. Frequency response of LTI systems by DTFT.
3. To perform Discrete Fourier Transform.
4. To implement Circular Convolution of two discrete time sequences.
5. To perform Overlap Add method of DFT for long data sequence.
6. To implement the algorithm of DIT-Fast Fourier Transform.
7. To plot the FFT of Sinusoids with noise.
8. Magnitude and phase response of FIR filter.
9. Design an Analog Butterworth filter with given specifications.
10. Design a Digital IIR Butterworth filter with given specifications.
11. Design an FIR filter by window method.
12. Removal of Noise by a designed filter.

Evaluation Scheme:

Continuous Assessment (A):

Laboratory work shall consist of minimum 8 experiments and subject specific lab assignment/case study/mini project.

The distribution of marks shall be as follows:

1. Performance in Experiments: 05 Marks
2. Journal Submission: 05 Marks
3. Viva-voce: 05 Marks
4. Subject Specific Lab Assignment/Case Study/mini project: 10 Marks

The final certification and acceptance of laboratory journal/manual/report will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the teacher assessment.

End Semester Examination (C):

Oral / Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.