Marwadi University
Faculty of Technology
Department of Information and Communication Technology

Subject Code: 01CT0513

Subject Name: Digital Signal and Image Processing

B. Tech. Year – III (Semester V)

Objective: The objective of the course is to provide understanding of discrete time signals and systems. Students learn to apply time, space and frequency domain operations, design of digital filters, apply image processing algorithms and understand DSP processors.

Credits Earned: 04 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Understand the concepts of discrete time signals and systems. (Understand)
2. Formulate mathematical formulas for discrete processing functions. (Analyze)
3. Analyze discrete signals using different time, space and frequency domain algorithms and compare their performance. (Analyze)
4. Apply signal and image processing algorithms for suitable applications. (Apply)
5. Design discrete-time systems such as digital filters. (Apply)

Pre-requisite of course: Signals and Systems, Linear Algebra

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial / Practical Marks		Total Marks
				E	I		V	T	
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term Work	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction:** A review of continuous and discrete time signals and systems, representing an image, spatial and gray level resolution, aliasing, zooming and shrinking an image, relationship between pixels	4
2	**Time and space domain operations:** Correlation, convolution, gray level transformations, Histogram processing, spatial filtering, non-linear spatial filters	7
3	**Frequency domain operations:** Z transform, Fourier transform, frequency analysis of discrete- time signals, Discrete fourier transform and its properties, Fast Fourier transform and its applications, linear filtering approach to compute FFT, The Goertzel algorithm, The Chirp-z algorithm, two dimensional DFT and its inverse, smoothing and sharpening frequency domain filters, Homomorphic filtering	11

4	**Implementation of discrete-time systems:** Block diagram and signal flow diagram representations of linear constant-coefficient difference equations, structures for FIR systems, structures for IIR systems, state space analysis and structures	4
5	**Design of digital filters:** Digital filters, FIR filters, design of linear phase FIR filers: using windowing method, using frequency sampling method, using optimal FIR filter design method, design of IIR filers from analog filters, design of digital low pass, band pass, band stop, high pass Butterworth filter	8
6	**Morphological image processing:** Dilation, erosion, opening, closing, hit-or miss transformation, boundary extraction, region filling, convex hull, thinning, thickening, skeletons, pruning	4
7	**DSP processors:** Importance of DSP processors, hardware units, VLIW architecture, pipelining, applications of DSP	4
	Total Hours	**42**

Suggested Text books / Reference books:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithm & Application”, 4th edition, Pearson
2. Alan V. Oppenhiem, Ronald W. Schafer, John R Buck, “Discrete Time Signal Processing”, 2nd edition, Person
3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd edition, Prentice-Hall, 2008
4. B. Venkataramani, M. Bhaskar “Digital Signal Processors: Architecture, Programming and Applications”, 2nd edition, Tata McGraw-Hill
5. V. Udayashankara, “Modern Digital Signal Processing”, 2nd edition, PHI

Suggested Theory distribution:

The suggested theory distribution as per Bloom’s taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	20%	25%	15%	10%	20%

Suggested List of Experiments: Minimum 14 experiments to be performed during the semester

1. Simulate discrete time sequences.
2. Simulate linear convolution and circular convolution on discrete time signals.
3. Simulate cross correlation and autocorrelation on discrete time signals.
4. Design Butterworth and Chebyshev filter using bilinear transformation method.
5. Design FIR filter with windowing method.
6. Perform FFT and IFFT on discrete time signal.
7. Perform gray level operations images.
8. Generate Histogram of images, apply Histogram equalization and Histogram matching on it.
9. Simulate smoothing and sharpening operation on images using spatial filters.
10. Apply non-linear filters on images and investigate its application in noise-removal.
11. Simulate smoothing and sharpening operations on images using frequency domain filters.
12. Simulate dilation, erosion, opening and closing operation on images.
13. Simulate Hit or Miss Transformation on images.
14. Simulate Boundary Extraction on images.
15. Study audio data acquisition using DSK6713 board.

Supplementary Resources:

1. https://nptel.ac.in/courses/117102060
2. https://nptel.ac.in/courses/108106151
3. https://nptel.ac.in/courses/117105135