

COURSE TITLE	DIGITAL SIGNAL AND IMAGE PROCESSING
COURSE CODE	01CT1513
COURSE CREDITS	4

Objective:

- 1 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.

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

- 1 Formulate mathematical formulas for discrete processing functions
- 2 Analyze discrete signals using different time, space and frequency domain algorithms and compare their performance.
- 3 Apply signal and image processing algorithms for suitable applications.
- 4 Apply image filtering techniques to process and enhance digital images and implement image filtering algorithms using relevant software tools
- 5 Design discrete-time systems such as digital filters

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

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

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	3
2	Time and space domain operations Correlation, convolution, gray level transformations, Histogram processing, spatial filtering, non-linear spatial filters, Image degradation model, Noise characterization, Noise restoration filters	8
3	Frequency domain operations Discrete Fourier transform and its properties, Fast Fourier transform and its applications, linear filtering approach to compute FFT, The Goertzel algorithm, two dimensional DFT and its inverse, smoothing and sharpening frequency domain filters, Homomorphic filtering	7
4	Color Image Processing and Image Compression Pseudo color Image Processing, Color Models, Image Compression codecs(JPEG, PNG, GIF)	4

Contents : Unit	Topics	Contact Hours
5	Design of digital filters Digital filters, FIR filters, design of linear phase FIR filters: using windowing method, frequency sampling method, using optimal FIR filter design method, design of IIR filters from analog filters, design of digital low pass, band pass, band stop, high pass Butterworth filter	8
6	Morphological image processing and Image Segmentation Dilation, erosion, opening, closing, hit-or miss transformation, boundary extraction, region filling, convex hull, thinning, thickening, skeletons, pruning, Edge Models Discontinuity based Image Segmentation, Similarity based Image Segmentation	8
7	DSP processors Importance of DSP processors, hardware units, VLIW architecture, pipelining, applications of DSP	4
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment-1 Simulate discrete time sequences	2
2	Experiment-2 Simulate linear convolution and circular convolution on discrete time signals.	2
3	Experiment-3 Simulate cross correlation and autocorrelation on discrete time signals.	2
4	Experiment-4 Design Butterworth and Chebyshev filter using bilinear transformation method.	2
5	Experiment-5 Design FIR filter with windowing method.	2
6	Experiment-6 Perform FFT and IFFT on discrete time signal.	2
7	Experiment-7 Perform gray level operations images.	2
8	Experiment-8 Generate Histogram of images, apply Histogram equalization and Histogram matching on it.	2
9	Experiment-9 Simulate smoothing and sharpening operation on images using spatial filters.	2
10	Experiment-10 Apply non-linear filters on images and investigate its application in noise-removal.	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
11	Experiment-11 Simulate smoothing and sharpening operations on images using frequency domain filters.	2
12	Experiment-12 Simulate dilation, erosion, opening and closing operation on images.	2
13	Experiment-13 Simulate Hit or Miss Transformation on images.	2
14	Experiment-14 Simulate Boundary Extraction on images.	2
15	Experiment-15 Study audio data acquisition using DSK6713 board.	2
16	Experiment-16 To write a program that provide an Interactive Segmentation for selective object of interest and apply the user specified effect on the background	2
Total Hours		32

Textbook :

- 1 Digital Signal Processing: Principles, Algorithm & Application, John G. Proakis and Dimitris G. Manolakis, Pearson, 2020
- 2 Discrete Time Signal Processing, Alan V. Oppenheim, Ronald W. Schaffer, John R Buck, Person, 2019
- 3 Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Prentice-Hall, 2008

References:

- 1 Digital Signal Processors: Architecture, Programming and Applications, Digital Signal Processors: Architecture, Programming and Applications, B. Venkataramani, M. Bhaskar , Tata McGraw-Hill, 2010
- 2 Modern Digital Signal Processing, Modern Digital Signal Processing, 5. V. Udayashankara, 2nd edition, PHI, 2012

Suggested Theory Distribution:

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

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	15.00	10.00	20.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. for effective teaching.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of the semester for evaluation of performance of students in laboratory.
- 4 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.
- 5 The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

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