Chapter 1 : Introduction to Digital Signal Processing **1-1 to 1-18**

Syllabus :

Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, reversal, scaling, addition, multiplication).

1.1 Introduction 1-1
1.1.1 Digital Signal Processing System 1-2
1.1.2 Advantages of Digital Signal Processing over Analog Signal Processing 1-3
1.1.3 Difference between DSP and ASP 1-3
1.1.4 Limitations of Digital Signal Processing 1-4
1.2 Signals 1-4
1.2.1 Continuous and Discrete Time Signals 1-4
1.2.2 Continuous Valued and Discrete Valued Signals 1-6
1.2.3 Deterministic and Random Signals 1-6
1.3 Concept of Frequency in the Continuous and Discrete Time Signals 1-6
1.3.1 Concept of Frequency in Continuous Time Signals 1-6
1.3.2 Concept of Frequency in Discrete Time Signals 1-7
1.3.3 Converting a Analog Signal to a Discrete Time Signal 1-8
1.4 Aliasing and Nyquist Rate 1-9
1.4.1 Anti Aliasing Filter 1-13
1.5 Basic Elements of a DSP System 1-13
1.5.1 Solved Examples 1-14
1.6 Applications of DSP 1-18

Chapter 2 : Discrete Time Signal and System **2-1 to 2-29**

Syllabus :

Classification of Discrete-Time Signals, Classification of Discrete- Systems Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution

2.1 Introduction 2-1
2.1.1 Representation of Discrete Time Signals 2-1
2.1.2 Elementary Discrete Time Signals 2-2
2.2 Classification of Discrete Time Signals 2-4
2.2.1 Even and Odd Signals 2-5
2.2.2 Periodic and Aperiodic Signals 2-7
2.2.3 Energy and Power Signals 2-8
2.3 Operation on Signals 2-10
2.3.1 Time Shifting 2-11
2.3.2 Time Reversal 2-12
2.3.3 Time Scaling 2-12
2.3.4 Scalar Multiplication 2-13
2.3.5 Signal Addition and Multiplication 2-14
2.3.6 Solved Examples on Signals 2-14
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2.4.1 Representation of a Signal in Terms of Weighted Sum of Shifted Discrete Impulse 2-21
2.5 Impulse Response and Convolution 2-21
2.5.1 Computation of Linear Convolution 2-22
2.5.2 Linear Convolution using Graphical Method 2-22
2.5.2(A) Solved Examples on Graphical Method 2-23
2.5.3 Linear Convolution using Tabular Method 2-26
2.5.3(A) Solved Examples on Tabular Method 2-27
2.6 Correlation 2-28
2.6.1 Solved Examples on Correlation 2-28

Chapter 3 : Discrete Fourier Transform (DFT) **3-1 to 3-65**

Syllabus :

Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT, Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time, Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties. Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Spectral Analysis using FFT

3.1 The Fourier Transform 3-1

3.2 Discrete Time Fourier Transform 3-2
3.2.1 Solved Examples on DTFT of Standard Signals 3-2
3.3 Relationship between DTFT and DFT 3-4
3.4 Discrete Fourier Transform (DFT) 3-4
3.4.1 Solved Examples on DFT of Simple Signals 3-5
3.5 The Fourier Spectrum 3-13
3.6 Inverse Discrete Fourier Transform (IDFT) 3-14
3.7 Computing DFT by Matrix Method 3-15
3.7.1 Solved Examples of DFT 3-16
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3.8.2 Periodicity 3-30
3.8.3 Circular Time Shift 3-31
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3.9.1(A) Solved Example on Concentric Circle Method 3-47
3.9.2 Matrix Method 3-51
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Chapter 4 : Fast Fourier Transform 4-1 to 4-42

Syllabus :

Need of FFT, Radix-2 DIT-FFT algorithm, DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.

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4.2 Computational Complexity of DFT 4-1
4.3 Decimation In Time FFT (DIT-FFT) 4-2
4.4 Bit Reversal Format 4-6
4.4.1 Solved Examples on Bit Reversal Format 4-6
4.5 Decimation in Frequency FFT (DIT-FFT) 4-17
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4.6 Computational Complexity Comparison between DFT and FFT 4-30
4.6.1 Solved Examples on Computation of Inverse DFT using FFT Algorithms 4-31
4.6.2 Filtering using FFT Algorithms 4-37

Chapter 5 : Introduction to Image Processing 5-1 to 5-14

Syllabus :

Introduction to Digital Image, Digital Image Processing System, Image File Formats : BMP, TIFF and JPEG.

5.1 Introduction 5-1
5.2 What Do We Mean by Image Processing ? 5-1
5.3 Images 5-2
5.4 The Electromagnetic Spectrum 5-3
5.5 Units of Intensity 5-3
5.6 Basic Elements/Steps of an Image Processing System 5-4
5.7 Image Types 5-9
5.8 Image File Formats 5-12
5.9 Image Processing, Computer Graphics and Computer Vision 5-13

Chapter 6 : Sampling and Quantization 6-1 to 6-10

Syllabus :

Sampling and Quantization. Representation of Digital Image

6.1 Introduction 6-1
6.2 Sampling 6-1
6.3 Quantization 6-5
6.4 Isopreference Curves 6-8
6.5 Non-uniform Sampling 6-9
6.6 Physical Resolution 6-9
6.6.1 Solved Examples on Physical Resolution 6-9

Chapter 7 : Image Enhancement in Spatial Domain 7-1 to 7-46

Syllabus :

Gray Level Transformations, Zero Memory Point Operations, Neighborhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.

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7.2 Spatial Domain Methods 8-1
7.3 Point Processing 8-2
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7.3.3 Thresholding....8-4
7.3.4 Grey Level Slicing (Intensity Slicing)....8-5
7.3.5 Bit Plane Slicing 8-7
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7.8 Zooming....8-30
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Chapter 8 : Histogram Modelling 8-1 to 8-20

Syllabus :

Histogram Processing, Histogram equalization.

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8.1.1 Mean and Standard Deviation of Histogram 8-3
8.2 Linear Stretching 8-3
8.2.1 Solved Examples on Linear Stretching 8-3
8.3 Histogram Equalization....8-6
8.3.1 Solved Examples on Histogram Equalization 8-7
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8.4.1 Solved Example Histogram 8-12
8.5 Solved Examples on Histogram Modelling....8-13

Chapter 9 : Segmentation 9-1 to 9-23

Syllabus :

Segmentation based on Discontinuities (point, Line, Edge), Image Edge detection using Robert, Sobel, Previtt masks, Image Edge detection using Laplacian Mask. Connectivity

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9.2 Image Segmentation based on Discontinuities 9-2
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9.2.2 Line Detection 9-2
9.2.3 Edge Detection....9-3
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9.6.1 Solved Examples on Connectivity....9-18
9.7 Distance Transform 9-18
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9.8 Additional Solved Examples 9-19

- **Appendix A : Solved University Q-Paper of Dec. 2019 ....A-1 to A-7**

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