Information Booklet cum Syllabus

Of

DSP using MATLAB

Revision-I

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National Institute of Electronics and Information Technology

An Autonomous Scientific Society under

Ministry of Electronics and Information Technology, Government of India

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CONTENTS

1. About Course

Digital Signal processing is essential for a wide range of applications, from data science to real-time embedded systems. MATLAB make it easy to use signal processing techniques to explore and analyze time-series data, and they provide a unified workflow for the development of embedded systems and streaming applications. With the use of MATLAB we can:

- Acquire, measure, and analyze signals from many sources.
- Design streaming algorithms for audio, smart sensor, instrumentation, and IoT devices.
- Prototype, test, and implement DSP algorithms on PCs, embedded processors, SoCs, and FPGAs.

2. NIELIT

National Institute of Electronics and Information Technology, NIELIT, (Erstwhile DOEACC Society) is an autonomous scientific society of the Ministry of Electronics & Information Technology, Government of India. The Society is registered under the Societies Registration Act, 1860. NIELIT was set up to carry out Human Resource Development and related activities in the area of Information, Electronics & Communications Technology (IECT). NIELIT is engaged both in Formal & Non-Formal Education in the areas of IECT besides development of industry oriented quality education and training programmes in the state-of-the-art areas. NIELIT has endeavored to establish standards to be the country's premier institution for Examination and Certification in the field of IECT. It is also one of the National Examination Body, which accredits institutes/organizations for conducting courses in IT and Electronics in the non-formal sector.

3. Objective of Course

In this course, students will explore the vast world that is digital signal processing. Students will undertake lessons in fundamentals such as discrete mathematics, signal and system representations, discrete Fourier and z-transforms and many others. All of these concepts are reinforced by example and practice using the MATLAB computational software package. After acclimating with the language and methods of DSP, students will then be ushered through a variety of interesting and practical real-world applications, including filter design, Image processing & Simulink.

4. Job Roles of Course

After successful completion of the qualification the candidates shall be employed in the industries for following occupations:

- MATLAB Programmer & Engineer
- Scientist & Researcher in Pvt. & Govt. Sectors
- Digital Signal Processing Engineer
- Audio signal Processing Engineer

- Biomedical signal Processing Engineer
- Data Scientist
- Radar Signal Processing Engineer.

5. Eligibility

Pursing Diploma/Graduation

6. Total duration of the Course

80 Hours (Theory: 28 Hrs., Practical/Tutorial: 52 Hrs)

7. Course Details

7.1.Course Outline and Objective of Each Unit

S. No.	Unit Name	Duration (Theory) in Hours	Duration (Practical) in Hours	Total Learning Hrs.	Learning Objectives
1	Introduction to MATLAB and Simulink	5	15	20	After completion of this unit of module, Learner will be able to • Perform Basic Matrix operation using MATLAB • Plot various 2-D and 3-D curves used in analysis of any scientific problem • Perform all the Engineering Mathematics Problems using MATLAB • Simulate various models in SIMULINK
2	Discrete Time Signals	4	6	10	After completing this unit, Learner will be able to understand • Perform sampling of Signal • Calculate energy of a signal • Calculate power of a signal • Perform Convolution on DT Signal • Perform Autocorrelation on DT Signal.

3	Z-transform	4	6	10	After completing this unit, Learner will be able to understand • Perform Z -transform of Discrete Sequence • Perform Inv-Z -transform of Discrete Sequence • Plotting of Pole-Zero graph • Check stability and Unstability of the system • Check causal and Non causal system.
4	Discrete Fourier Transform (DFT)	4	6	10	After completing this unit, Learner will be able to understand • Perform DFT on a DT sequence • Perform IDFT on a DT sequence • Perform Circular Shift on DT sequence • Perform Circular Convolution on a DT sequence • Calculate Complex conjugate on a DT sequence.
5	Fast Fourier Transform (FFT)	4	6	10	After completing this unit, Learner will be able to understand • Perform FFT on a DT signal • Can perform frequency Domain Analysis • Plot magnitude and Phase Response • Analysis of system/ signal behavior
6	Filter Designing	3	7	10	After completing this unit, Learner will be able to understand • Designing of IIR filters • Designing of FIR filters • Design of Filters using FDA and Win Tool box • Design of Filters using

					SP Tool box
7	Basics of Image processing	4	6	10	After completion of the project students will • Import images in MATLAB • Perform various operations on images • Perform Conversion of images

7.2.Detailed Syllabus

Unit Name	Contents	Hrs.
Introduction to MATLAB and Simulink	**Introduction to MATLAB** • Introduction to MATLAB • Features and uses of MATLAB **Matrices and Array Operations**. • Row, column vectors • Vector operations- Addition, Subtraction, multiplications etc. • Transpose, conjugate, determinant and inverse of a Matrix **Plotting and Graphics.** • Adding Title, Labels, Grid Lines, and Scaling on the Graph • Drawing Multiple Functions and sub plotting • Setting Colours, Axis Scales • Drawing Bar Charts, contours and 3D plots **Engineering Mathematics** • Algebra • Calculus • Polynomials • Elementary Transforms **Simulink Modeling** • Mathematical Models • Electrical Models	20

Discrete Time Signals	**Discrete-time signals** • Sampling and reconstruction of signals. • Discrete Sequences • Periodic, energy, power, • Unit sample, unit-step, unit-ramp, real & complex exponentials, **Arithmetic operations on sequences.** • Shifting • Time Reversal • Convolution • Autocorrelation	10
Z-transform	**Z-Transform & Inverse Z- Transform** • Definition, Convergence and ROC of Z-Transform. • Properties of Z-transform. • Linearity • Time Shifting & Scaling • Time Difference & reversal • Conjugate • Convolution and Correlation	10
Discrete Fourier Transform (DFT)	**DFT & IDFT** • DFT & IDFT Properties • Periodicity • Circular Shift &Time Reversal • Complex Conjugate & Circular convolution • Multiplication & Parsavel Therom • Symmetry Property etc.	10
Fast Fourier Transform (FFT)	• Decimation-in-time algorithms (DIT) • Decimation-in-frequency algorithms(DIF) • FFT computation using MATLAB	10
Filter Designing	• Basic concepts of IIR filters • Basic concepts of FIR filters • Design of IIR filters • Design of FIR filters • Windows Technique. • Filter Design and Analysis Toolbox(FDA)	10
Basics of Image processing	• Basics of Image Processing • Types of Images • Basic image Operations • Image conversion • Noise in images	10

8. Reference Books/Study Material

- Quinquis, A., Radoi, E., Ioana, C., & Mansour, A. (2008). Digital signal processing using MATLAB (p. 424). John Wiley & Sons.
- Digital Signal Processing Using Matlab A Problem Solving Companion by Vinay K. Ingle, John G. Proakis any edition
- Challis, J. H. (2007). Signal Processing for Neuroscientists: An Introduction to the Analysis of Physiological Signals. Journal of Motor Behavior, 39(2), 158.
- https://www.mathworks.com/
- https://www.tutorialspoint.com/matlab/index.htm

9. Practical Assignments

Assignment 1. Perform verification of sampling theorem using MATLAB
Assignment 2. Program to obtain Linear Convolution of two finite length sequences
Assignment 3. To find frequency response of a given system(transfer function/ difference equation)
Assignment 4. Implementation of FFT of given sequence
Assignment 5. Implementation of LP FIR filters for a given sequence.
Assignment 6. Implementation of HP FIR filter for a given sequence.
Assignment 7. Impulse Response of First Order and Second Order Systems
Assignment 8. To find DFT / IDFT of given DT signal
Assignment 9. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum