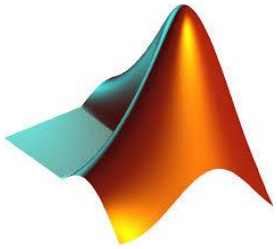

LIT Susant K Rout's Center of Excellence

LEARN MATLAB FROM EXPERT.

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, Fortran and Python.

COURSE OUTLINE

FUNDAMENTAL S AND PROGRAMMING TECHNIQUES

A compressive coverage of MATLAB right from scratch up to programming and scripting functions. The course also touches upon advanced topics like data analysis, data import/export, structures, curve-fitting, regression, vectorization, debugging, etc. The course discusses guidelines for optimal and efficient programming in Matlab. This course is a must for those intending to start using Matlab for algorithm building in industry, academia or research. Request us a peek into the course.

COURSE CONTENT

MATLAB PRODUCT DESPRICTION	• Key features • Architecture • Installation of MATLAB • Use of MATLAB
MATLAB Simulation Software	• Introduction to MATLAB Software • MATLAB windows

	• Command Window • Editor Window • Workspace • Command History • Current directory • Working with the MATLAB user interface
Working with data files and data types	• Data types ❖ Numeric ❖ String • Data type conversion ❖ Numeric to String ❖ String to Numeric
Operators & Special characters	• Arithmetic operators • Bit-Wise Operators • Relational Operators • Logical Operators • Set operations • Special chracters
Complex Numbers & Trigonometric functions	To work with complex numbers and trigonometric functions in MATLAB
Matrices and Arrays	• Array Initializations • About Matrices • Generating Matrices • Matrix Sum, transpose, diagonal, inverse • Matrix Multiplication, division • The magic Function • Matrix and Array Operations • Matrices and Magic Squares • Generating Arrays Using MATLAB Function
Types of Arrays	• Multidimensional Arrays • Extending Multidimensional Arrays • Structures • Cell Arrays
Loops and Conditional Statements	• Control Flow

	• Conditional Control — if, else, switch • Loop Control — for, while, continue, break • Program Termination — return
Functions	• Writing user defined functions • Built in Function • Function calling • Return Value • Types of Functions • Global Variables
Plots	• Plotting vector and matrix data • Plot labelling, curve labelling, legend and colour bar editing Plot types **2-D Plots** • Basic Plotting Functions • Creating a Plot • Plotting Multiple Data Sets in One Graph • Specifying Line Styles and Colors • Graphing Imaginary and Complex Data • Figure Windows • Displaying Multiple Plots in One Figure • Controlling the Axes **3-D Plots** • Creating Mesh and Surface • About Mesh and Surface Visualizing • Subplots Examples: Deal with complex plot
M-Files	• The MATLAB Editor • Script M-files • The MATLAB path • Function M-files • Sub-functions and nested functions • Debugging

	• Best script file writing tactics
MATLAB Programming	• Automating commands with scripts • Writing programs with logic and flow control • Writing functions • Control statement Programming • Conditional Statement Programming • Examples
Symbolic Math in MATLAB	• Calculus: Numerical Integration • Linear Algebra • Roots of Polynomials • Algebraic and Differential Equations (First Order, second order) • Transforms (Fourier, Laplace, etc)
Publishing Report	• Create the cell script • Execute the cell script • Publish the Script in HTML • Publish the script in LATEX • Report Generation
Different application in MATLAB	• Statistical parameter estimations • DSP applications • Image Processing applications • Control System applications • Robotics Application • Financial Application • Time-Series Application

Prerequisites: Undergraduate-level mathematics and experience with basic computer operations

Intermediate Course

Intermediate courses are design for the students who are interested to be an expert in MATLAB. The followings represents the details of course outline.

COURSE CONTENT

Graphical User Interface Design	• **Introduction Of GUI** • **GUI Function Property** • **GUI Component Design** • **GUI Container** • **Writing the code of GUI Callback** • **Dialog Box** • **Menu Designing** • **Applications**
MATLAB Simulink	• **Introduction Of Simulink** • **Simulink Environment & Interface** • **Study of Library** • **Circuit Oriented Design** • **Equation Oriented Design** • **Connectivity** • **Model** • **Subsystem Design** • **Connect Call back to subsystem** • **Application**
MATLAB for Financial Applications Computational Finance	• **Time-series analysis** • **Fixed-income security valuation** • **Portfolio management** • **Options and derivatives** • **Monte Carlo simulation** • **Representing dates and durations** • **Performing calculations with dates and durations** • **Extracting numeric components of dates and durations**

	• **Applying mathematical operations to variables** • **Performing calculations efficiently using numerical operations** • **Calculating descriptive data statistics**
Optimization Techniques in MATLAB This course introduces applied optimization in the MATLAB environment, focusing on using Optimization Toolbox™ and Global Optimization Toolbox™. Running optimization problems in MATLAB	• **Specifying objective functions** • **Specifying constraints** • **Choosing solvers and algorithms** • **Evaluating results and improving performance** • **Using global optimization methods** • **Identifying the problem components** • **Running an optimization using Optimization Tool** • **Applying the optimization process** • **Using optimization functions** • **Using an objective function file** • **Specifying objective functions with function handles** • **Passing extra data to objective functions** **Specifying Constraints** • **Identifying different types of constraints** • **Defining bounds** • **Defining linear constraints** • **Defining nonlinear constraints** **Global Optimization** • **Finding the global minimum** • **Using genetic algorithms to solve discrete problems**
Statistical Methods in MATLAB	**Importing and Organizing Data** • **Data types** • **Dataset arrays** • **Merging data** • **Categorical data** • **Missing data** **Exploring Data** • **Central tendency**

	• **Spread** • **Shape** • **Correlations** • **Grouped data** **Distributions** • **Probability distributions** • **Distribution parameters** • **Comparing and fitting distributions** • **Nonparametric fitting** • **Distribution objects** **Hypothesis Tests** • **Tests for normal distributions** • **Tests for non-normal distributions** **ANOVA Testing** • **One-way ANOVA** • **N-way ANOVA** • **MANOVA** • **Nonnormal ANOVA** • **Categorical correlations** **Regression** • **Linear regression models** • **Fitting linear models to data** • **Evaluating the fit** • **Adjusting the model** • **Logistic and generalized linear regression** • **Nonlinear regression**
Machine Learning with MATLAB	**Importing and Organizing Data** • **Data types** • **Tables** • **Categorical data** • **Data preparation** **Finding Natural Patterns in Data** • **Unsupervised learning** • **Self-Organizing Maps** • **Clustering methods** • **Cluster evaluation and interpretation** **Building a Predictive Model** • **Supervised learning** • **Training and validation** • **Classification methods** • **Neural Networks**

	• **Wilcoxon Rank based Learning**
Risk Management with MATLAB ***(MATLAB for Financial Applications* and knowledge of risk management concepts)**	• **Creating market and sector baselines** • **Computing risk metrics for a given portfolio** • **Computing portfolio betas** • **Computing relative portfolio risk** • **Creating and simulating market risk models** • **Identifying and modeling serial autocorrelation and GARCH effects** • **Risk-oriented GARCH time-series models** • **Extreme-value theory and copulas** • **Filtered historical bootstrapping** • **Estimating transition probabilities from credit ratings migration data** • **Determining credit quality thresholds** • **Forecasting corporate default rates** • **Pricing fixed-income securities**
Signal Processing in MATLAB	• Introduction to DSP • Creating discrete signals • Sampling and resampling • Visualizing signals • Modeling noise • Performing resampling, modulation, and correlation **Spectral Analysis** • Windowing and zero padding • Power spectral density estimation • Time-varying spectra • Using a spectrum analyzer in MATLAB

	Linear Time Invariant Systems • LTI system representations • z-transform • Frequency and impulse response • Visualizing filter properties • Applying filters to finite and streaming signals **Filter Design** • Interactive filter design • Common filter design functions • Filter design with filter specification objects • Reducing filter delay • Frequency-domain filtering **The Signal Analysis App** • Browse signals and make simple measurements • Perform interactive spectral analysis • Design and apply filters to signals interactively Multirate Filters • Downsampling and upsampling • Noble identities and polyphase FIR structures • Polyphase decimators and interpolators • Design multistage and interpolated FIR filters **Adaptive Filter Design** • Basics of adaptive filtering • Perform system identification • Perform noise cancellation • Improve adaptive filter efficiency
Principle of Soft Computing (Tool Box Application)	**Introduction to Soft Computing** **Fuzzy Logic System** • **Mamdani Fuzzy System** • **Takagi-Sugeno-Kang** • **ANFIS**

	Artificial Neural Network • **MLP (Multi-layer Perceptron)** • **RBF (Radial basis Function)** • **RNN (Recurrent Neural Network)** • **Hoffman Neural Network** **Function Approximation** **System Identification** **Evolutionary Algorithm** • **Genetic Algorithm**
Image Processing with MATLAB	**Importing and Visualizing Images** • **Importing and displaying images** • **Converting between image types** • **Exporting images** • **Importing and playing video files** **Interactive Exploration of Images** • **Obtaining pixel intensity values** • **Extracting a region of interest** • **Computing pixel statistics on a region of interest** • **Measuring object sizes** • Creating a custom interactive tool **Preprocessing Images** • **Adjusting image contrast** • **Reducing noise in an image** • **Using sliding neighborhood operations** • **Using block processing operations** **Spatial Transformation and Image Registration** • **Create a panoramic scene by stitching images.** • **Geometric transformations** • **Image registration using point mapping** • **Creating a panoramic scene** **Edge and Line Detection** • **Segmenting object edges** • **Detecting straight lines** • **Performing batch analysis over sets of images**

	• **Detecting circular objects** **Color and Texture Segmentation** • **Color space transformation** • **Color segmentation** • **Texture segmentation** • **Texture based image classification** **Feature Extraction** • **Counting objects** • **Measuring shape properties** • **Using morphological operations** • **Performing watershed segmentation**
Interfacing MATLAB with C Code	**MEX-File Overview** • Introduction to MEX-files • Applications of MEX-files • Components of a MEX-file • Setting up MATLAB to compile MEX-files • Building and running a MEX-file **MEX-Files with Inputs and Outputs** • Data flow in MEX-files • MATLAB data • The mxArray class • Working with pointers • Working with mxArray API functions • Working with strings • When to use MEX-files • Handling data **MEX-File Interface Considerations** • Displaying diagnostic messages • Memory allocation and deallocation • Preventing memory leaks • Working with input and output memory • Debugging MEX-files **Calling MATLAB from C Code** • Data flow in MATLAB engine applications • Calling the MATLAB engine • Compiling and running MATLAB engine applications