KOENIG
step forward

MATLAB Fundamentals for Beginners

1. Title

MATLAB Fundamentals for Beginners

2. Target Audience

This course is designed for students, engineers, researchers, and technical professionals with no prior programming experience who want to build a solid, practical foundation in MATLAB. It suits undergraduate and graduate students in engineering, mathematics, and science programs, as well as working professionals in electrical, mechanical, and computational fields who need MATLAB for data analysis, scientific computing, and visualization. No prior coding background is required — only basic familiarity with algebra and matrix concepts is helpful. Learners take this course to gain hands-on command of MATLAB's core environment, functions, plotting tools, and programming constructs so they can confidently apply MATLAB to real-world engineering and scientific problems.

3. Course Outcomes

By the end of this course, learners will be able to:

- Understand the MATLAB desktop environment, syntax, and core operators.
- Apply arithmetic, relational, and logical operators to solve computational problems.
- Create and manipulate arrays, matrices, and complex numbers.
- Analyze data using descriptive statistics and built-in mathematical functions.
- Design a full range of 2D and 3D visualizations for scientific and engineering data.
- Implement custom scripts and functions using MATLAB programming methods.
- Apply numerical methods to solve equations and engineering problems computationally.
- Evaluate symbolic math tools for algebraic and calculus-based problem solving.
- Troubleshoot and optimize MATLAB code for accuracy and efficiency.
- Prepare a working portfolio of MATLAB scripts covering data analysis, visualization, and numerical computation.

4. Course Objectives

- Provide a structured, progressive learning path from MATLAB basics to advanced plotting, programming, and numerical/symbolic methods.
- Build proficiency through hands-on coding exercises embedded in every module.
- Prepare learners for real-world MATLAB workflows in engineering, research, and data analysis.
- Reinforce every concept through practical examples and lab exercises that mirror real computational problems.
- Equip learners with the toolbox knowledge (Symbolic Math, Statistics and Machine Learning) needed to extend MATLAB beyond core functionality.

5. Course Outline

The course comprises 40 hours of theory and labs and is divided into 10 different chapters. Each chapter will be followed by hands-on lab exercises to reinforce learning and gauge understanding of the topics covered.

6. Table of Contents (TOC)

Module 1: Getting Started with MATLAB

- MATLAB desktop: Command Window, Workspace, Editor
- Toolstrips, panes, and the Current Folder browser
- Script vs. command-line execution
- Customizing preferences and desktop layout
- Using help and doc for documentation

Module 2: MATLAB Operators

- Arithmetic Operators in MATLAB (addition, multiplication, element-wise vs. matrix ops)
- Relational Operators in MATLAB (==, <, >, comparisons on arrays)
- Logical Operators in MATLAB (AND/OR/NOT, logical indexing)
- Operator precedence across arithmetic, relational, and logical operators
- Practical lab combining all three operator types

Module 3: Special Characters, Variables & Constants

- Special Characters in MATLAB (colon operator, comments, continuation)
- Special Variables and Constants in MATLAB (pi, Inf, NaN, ans)
- Using the colon operator for indexing and ranges

- Avoiding variable name conflicts with built-ins
- Practical lab using special characters and constants together

Module 4: Complex Numbers and Arrays

- Complex Numbers in MATLAB (creation, magnitude, phase, conjugates)
- Arrays and Matrices in MATLAB (creation, indexing, reshaping)
- Matrix operations: transpose, inverse, determinant
- Concatenation and array manipulation functions
- Practical lab solving a matrix-based engineering problem

Module 5: Statistics and Mathematical Functions

- Descriptive Statistics in MATLAB (mean, median, variance, std)
- Trigonometric Functions in MATLAB (sine, cosine, inverse, hyperbolic)
- Basic Functions in MATLAB (rounding, exponential, logarithmic)
- Applying built-in functions to sample datasets
- Practical lab analyzing a numeric dataset

Module 6: Plotting Fundamentals

- Plotting Features in MATLAB (plot, titles, labels, legends)
- 3-D Plot (plot3, viewing angle, axes)
- Stairstep Graph (stairs) for discrete data
- Line Plot with Error Bars (errorbar)
- Practical lab building a formatted 2D/3D plot

Module 7: Advanced 2D Plot Types

- Stacked Plot, Log-Log Plot, Semilog-X and Semilog-Y Plots
- Area Plot and Polar Coordinates Plot
- Bar Graph and Discrete Sequence Plot (Stem)
- Histogram Plot and 2D/3D Pie Charts
- Scatter Plot for correlation analysis
- Practical lab selecting the right plot type for sample data

Module 8: 3D and Field Visualization

- Contour Plot and Filled Contour Plot

- Vector Plot (Quiver) for field visualization
- 2D and 3D Streamline Plots
- Surface Plot (surf) and Mesh Surface Plot (mesh)
- Display Image (imshow, image)
- Practical lab visualizing a scalar/vector field

Module 9: Programming in MATLAB

- Writing and running MATLAB scripts
- Conditional statements: if, elseif, switch
- Loop structures: for and while
- Writing and calling user-defined functions
- Practical lab building a small program using control structures

Module 10: Numerical and Symbolic Methods

- Numerical Methods in MATLAB (root-finding, integration, interpolation)
- Solving systems of linear equations numerically
- Symbolic Math in MATLAB (symbolic variables, differentiation, integration)
- Solving and simplifying symbolic equations
- Practical lab solving one numerical and one symbolic problem