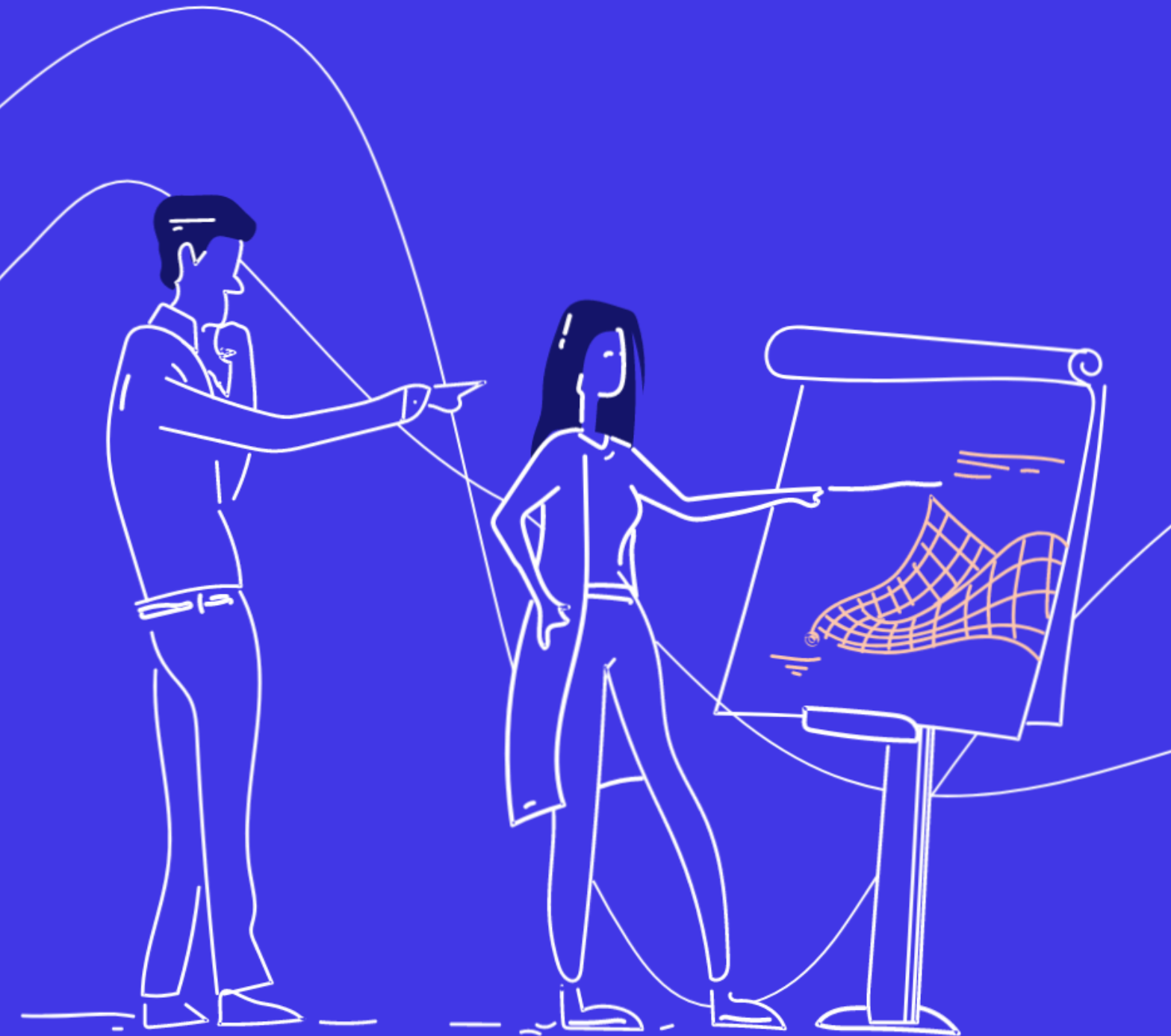




# IA&M Predictive Maintenance and Digital Twins Curriculum



SciEngineer's training courses are designed to help organizations and individuals close skills gaps, keep up-to-date with the industry-accepted best practices and achieve the greatest value from MathWorks® and COMSOL® Products.

**Core Model-Based  
Engineering Platform**

**MATLAB Fundamentals  
(3 Days)**

**MATLAB for Data Processing  
and Visualization  
(1 Day)**

**Processing Big Data  
with MATLAB  
(1 Day)**

**MATLAB Programming  
Techniques  
(2 Days)**

**Building Interactive  
Applications in MATLAB  
(1 Day)**

**Power Systems  
& Control**

**Predictive Maintenance  
with MATLAB  
(2 Days)**

**Battery Modeling**

**Simulink Fundamentals  
(2 Days)**

**Stateflow for Logic-Driven  
System Modeling  
(2 Days)**

**Control System Design with  
MATLAB and Simulink  
(2 Days)**

**Reinforcement Learning in  
MATLAB and Simulink  
(1 Day)**

**Architecting, Managing,  
Testing & Implementation**

**Modeling Physical Systems  
with Simscape  
(1 Day)**

**Modeling Multibody Mechanical  
Systems with Simscape  
(1 Day)**

**Modeling Fluid Systems with  
Simscape  
(1 Day)**

**Modeling Electrical Power Systems  
with Simscape  
(1 Day)**

**Power Electronics Control Design  
with Simulink and Simscape  
(1 Day)**

# MATLAB Fundamentals

This three-day course provides a comprehensive introduction to the MATLAB technical computing environment. Themes of data analysis, visualization, modeling, and programming are explored throughout the course. This course is intended for beginning users and those looking for a review.

## Prerequisites

Undergraduate-level mathematics and experience with basic computer operations.

[Detailed course outline »](#)

DURATION

3 Days

LEVEL

Basic

### TOPICS

## Day 1

- Working with the MATLAB User Interface
- Variables and Commands
- Analysis and Visualization with Vectors

## Day 2

- Analysis and Visualization with Matrices
- Tables of Data
- Conditional Data Selection
- Organizing Data

## Day 3

- Analyzing Data
- Increasing Automation with Programming Constructs
- Increasing Automation with Functions

# MATLAB for Data Processing and Visualization

This one-day course focuses on importing and preparing data for data analytics applications. Topics discussed include importing data from multiple sources, processing data, producing informative customized graphics and working with irregular data.

## Prerequisites

MATLAB Fundamentals

[Detailed course outline >>](#)

DURATION	LEVEL
1 day	Medium
<div> <div></div> <div></div> <div></div> </div>	<div> <div></div> <div></div> <div></div> </div>

### TOPICS

## Day 1

- Importing Data
- Processing Data
- Customizing Visualizations
- Working with Irregular Data



# Processing Big Data with MATLAB

This one-day course focuses on adapting existing algorithms to work with a dataset that is too big to fit in memory. You will learn represent big data in MATLAB, adjust existing code to work efficiently with it, and scale up the analysis to take advantage of your own computing resources or a cloud.

## Prerequisites

MATLAB for Data Processing and Visualization, or equivalent experience using MATLAB

[Detailed course outline >>](#)

DURATION  
1 day

LEVEL  
Medium

### TOPICS

## Day 1

- Prototyping Big Data Algorithms
- Handling Custom Data and Algorithms
- Working with Clusters and Clouds

# MATLAB Programming Techniques

This two-day course provides hands-on experience using the features in the MATLAB language to write efficient, robust, and well-organized code. These concepts form the foundation for writing full applications, developing algorithms, and extending built-in MATLAB capabilities. Details of performance optimization, as well as tools for writing, debugging, and profiling code are covered.

## Prerequisites

MATLAB Fundamentals or equivalent experience using MATLAB

[Detailed course outline >>](#)

DURATION

2 Days

LEVEL

Medium

### TOPICS

#### Day 1

- Structuring Data
- Managing Data Efficiently
- Utilizing Development Tools

#### Day 2

- Creating Robust Applications
- Structuring Code
- Verifying Application Behavior

# Building Interactive Applications in MATLAB

This one-day course demonstrates how to create an interactive user interface for your applications in the App Designer environment. You will learn about user interface controls, responsive components, extra dialog windows and how to use them to create a robust and user-friendly interface for your MATLAB app. No prior experience of programming graphical interfaces is required.

## Prerequisites

MATLAB Fundamentals

[Detailed course outline »](#)

DURATION
1 Day

LEVEL
Medium

### TOPICS

## Day 1

- Using the App Designer Environment
- Creating and Updating Plots
- Creating Responsive Components
- Managing Multiple Windows and Apps

# Predictive Maintenance with MATLAB

This two-day course focuses on data analytics, signal processing, and machine learning techniques needed for predictive maintenance and condition monitoring workflows. You will learn how to use MATLAB to import data, extract features, and estimate the condition and remaining useful life of equipment.

## Prerequisites

MATLAB Fundamentals

[Detailed course outline >>](#)

DURATION	LEVEL
2 days	Medium
<div> <div></div> <div></div> <div></div> </div>	<div> <div></div> <div></div> <div></div> </div>

### TOPICS

## Day 1

- Importing Data and Processing Data
- Finding Natural Patterns in Data
- Building Classification Models

## Day 2

- Exploring and Analyzing Signals
- Preprocessing Signals to Improve Data Set Quality and Generate Features
- Estimating Time to Failure

# Simulink Fundamentals

This two-day course provides a comprehensive introduction to the Simulink environment. It demonstrates how to create, modify Simulink models, improve simulation accuracy and speed and create reusable model components using subsystems, model references and libraries.

## Prerequisites

MATLAB Fundamentals

[Detailed course outline »](#)

DURATION

2 Days

LEVEL

Basic

### TOPICS

#### Day 1

- Creating and Simulating a Model
- Modeling Programming Constructs
- Modeling Discrete Systems
- Modeling Continuous Systems

#### Day 2

- Solver Selection
- Developing Model Hierarchy
- Modeling Conditionally Executed Algorithms
- Combining Models into Diagrams
- Creating Libraries



# Stateflow for Logic-Driven System Modeling

This two-day course shows how to model and simulate decision logic using Stateflow. The course focuses on how to employ flow charts, state machines, truth tables, state transition tables and component-based modeling in Simulink designs.

## Prerequisites

MATLAB Fundamentals and Simulink Fundamentals

[Detailed course outline >>](#)

DURATION	LEVEL
2 Days	Basic
<div> <div></div> <div></div> <div></div> </div>	<div> <div></div> <div></div> <div></div> </div>

### TOPICS

## Day 1

- Modeling Flow Charts
- Modeling State Machines
- Hierarchical State Diagrams
- Parallel State Diagrams

## Day 2

- Using Events in State Diagrams
- Calling Functions from Stateflow
- Truth Tables and State Transition Tables
- Component-Based Modeling in Stateflow

# Control System Design with MATLAB and Simulink

This two-day course provides a general understanding of how to accelerate the design process for closed-loop control systems using MATLAB and Simulink.

Topics included: control system design overview, system modeling, identification and analysis, control design and controller implementation.

## Prerequisites

MATLAB Fundamentals and Simulink Fundamentals or equivalent experience using MATLAB and Simulink. Also, an understanding of terminology and concepts related to common control systems.

[Detailed course outline >>](#)

DURATION  
2 Days  


LEVEL  
Medium  


### TOPICS

#### Day 1

- Control System Design Overview
- Model Representations
- System Identification
- Parameter Estimation
- System Analysis

#### Day 2

- Linearization
- PID Control in Simulink
- Classical Control Design
- Response Optimization
- Controller Implementation

# Reinforcement Learning in MATLAB and Simulink

This one-day course introduces reinforcement learning in the MATLAB® and Simulink® environments, focusing on using the Reinforcement Learning Toolbox™.

## Prerequisites

MATLAB Fundamentals and Simulink Fundamentals

[Detailed course outline >>](#)

DURATION  
1 Day

LEVEL  
Medium

### TOPICS

## Day 1

- Environment and Rewards
- Policy and Agent
- Neural Networks and Training
- Deployment

# Modeling Physical Systems with Simscape

This one-day course discusses how to model systems in several physical domains such as electrical, mechanical, and hydraulic. This course focuses on interpreting Simscape diagrams, combining them with Simulink models, modeling energy transfer between different physical domains, and creating userdefined Simscape components.

## Prerequisites

MATLAB Fundamentals and Simulink Fundamentals

[Detailed course outline »](#)

DURATION  
1 day

LEVEL  
Medium

### TOPICS

## Day 1

- Introduction to Simscape and the Physical Network Approach
- Working with Simscape Components
- Connecting Physical Domains
- Combining Simscape Models and Simulink Models
- Creating Custom Components with the Simscape Language

# Modeling Multibody Mechanical Systems with Simscape

This one-day course focuses on how to model rigid-body mechanical systems in the Simulink environment using Simscape Multibody. Topics include: modeling simple multibody systems, creating reusable models of mechanical systems, importing models from CAD software and combining Simulink, Simscape and Simscape Multibody blocks.

## Prerequisites

MATLAB Fundamentals, Simulink Fundamentals, and Modeling Physical Systems with Simscape

[Detailed course outline »](#)

DURATION  
1 day

LEVEL  
Medium

### TOPICS

## Day 1

- Introduction to Multibody Simulation
- Refining Components
- Assembling Mechanisms
- Importing CAD Models
- Connecting to Simscape and Simulink



# Modeling Fluid Systems with Simscape

This one-day course focuses on modeling fluid systems in Simulink using Simscape Fluids. Topics discussed include modeling fluid power systems, actuating and controlling fluid system models, modeling thermal liquid and gas cooling systems and exchanging heat between fluid domains.

## Prerequisites

MATLAB Fundamentals, Simulink Fundamentals, and Modeling Physical Systems with Simscape

[Detailed course outline »](#)

DURATION  
1 day

LEVEL  
Medium

### TOPICS

## Day 1

- Hydromechanical Systems
- Hydraulic Actuation and Control
- Thermal Liquid Systems
- Gas Systems

# Modeling Electrical Power Systems with Simscape

This one-day course discusses how to model electrical power systems in the Simulink environment using the Simscape Electrical Specialized Power Systems library. This course focuses on creating three-phase systems with passive elements and with electrical machines, analyzing and controlling electrical power systems, modeling power electronic components and speeding up simulation of electrical models.

## Prerequisites

MATLAB Fundamentals, Simulink Fundamentals, and Modeling Physical Systems with Simscape

[Detailed course outline »](#)

DURATION	LEVEL
1 day	Medium
<div> <div></div> <div></div> <div></div> </div>	<div> <div></div> <div></div> <div></div> </div>

### TOPICS

## Day 1

- Introduction to Three-Phase Systems
- Three-Phase Systems with Electrical Machines
- Controlling Electrical Machines
- Power Electronics

# Power Electronics Control Design with Simulink and Simscape

This one-day course focuses on modeling and controlling power electronic systems in the Simulink environment using Simscape Electrical. Themes of DC power electronic systems, converter model fidelity, linearization and control, three-phase power electronic systems, and motor control are explored throughout the course.

## Prerequisites

MATLAB Fundamentals, Simulink for System and Algorithm Modeling, and Modeling Physical Systems with Simscape

[Detailed course outline >>](#)

DURATION	LEVEL
1 day	Medium
<div> <div></div> <div></div> <div></div> </div>	<div> <div></div> <div></div> <div></div> </div>

### TOPICS

## Day 1

- Introduction to Power Electronics
- Converter Model Fidelity
- Linearization and Control
- Modeling Three-Phase Power Electronic Systems
- Motor Control

# The Value of an Experienced Training Expert

Our training courses are developed by MathWorks' team of training engineers with exclusive product knowledge gained from working closely with product developers. They acquire significant hands-on experience by using new products months before they are released and are always current on new capabilities.

## Learn Relevant Skills

Each course contains a set of learning objectives designed to help participants quickly master necessary skills. Our hands-on approach allows participants to practice, apply, and evaluate their knowledge in the classroom.

## Receive Expert Instruction

Our training employs industry-accepted best practices for adult learning and technical instruction, and has developed course content that facilitates a “Presentation, Practice, Test” approach to learning. All training engineers have been selected based on their theoretical knowledge, technical education, experience, and teaching ability.

## Increase Team Success Rates

According to post-training surveys, teams who receive 40 hours of training meet project objectives three times as often as those who receive 30 hours or less. This increase in training time raises the likelihood of meeting objectives by 90%.





# Expand your knowledge

