



MATLAB and Simulink for Engineers Training: Numerical Methods, Modelling and Control Loops



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Introduction:

MATLAB and Simulink for Engineers training, covering numerical methods, modelling and control loops, is a 5-day course for process, mechanical, electrical and control engineers that ends with a Validated Engineering Analysis and Simulink Model for a case system. Engineering units lose time when calculations live in spreadsheets, when plant and test data are cleaned by hand, and when control changes are tried on live equipment because no dynamic model exists. Nominees already run engineering calculations and review operating or test data, and every session is a hands-on lab. CoreConcept Training Center delivers this MATLAB and Simulink course.

Course Objectives:

- Organise engineering calculations in MATLAB using matrices, vectorised operations, scripts and reusable functions
- Import, clean and convert plant and test data, then present it in report-ready plots
- Fit polynomial and nonlinear models to equipment data and judge fit quality from residuals
- Solve engineering equations with root finding, numerical integration and ODE solvers, and filter measured signals
- Build Simulink models of dynamic systems and PID control loops and tune them against step response criteria
- Validate a model against measured data and optimise design or tuning parameters with constrained solvers

Target Audience:

- Process engineering teams responsible for heat and material balance checks and unit performance data
 - Mechanical engineering teams responsible for equipment performance curves and vibration data
 - Electrical engineering teams responsible for motor, drive and power system calculations
 - Control and instrumentation teams responsible for loop design, tuning and dynamic response checks
 - Reliability and technical support teams that analyse operating data to diagnose equipment behaviour
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Course Outline:

Day 1: MATLAB Environment, Matrices and Engineering Data Handling

- MATLAB Desktop, Command Window, Workspace and Live Editor Orientation
- Matrix and Array Creation, Indexing and Element-Wise Operations
- Vectorised Calculation Replacing Loops in Engineering Formulas
- Engineering Data Import With readtable From CSV and Spreadsheets
- Missing Values, Outliers and Unit Conversion in Plant Data

Day 2: Scripts, Functions, Plotting and Curve Fitting

- MATLAB Scripts Versus Functions With Input Checks and Comments
- Control Flow and Logical Indexing for Engineering Rule Checks
- plot, subplot and Figure Export for Engineering Reports
- polyfit Polynomial Regression and Goodness of Fit Residuals
- Nonlinear Least Squares Fitting of Pump and Valve Curves

Day 3: Numerical Methods, Differential Equations and Signal Processing

- fzero and fsolve Root Finding for Equilibrium Equations
- trapz and integral Numerical Integration of Measured Profiles
- ode45 Solution of First-Order Tank and Heat Balances
- ode15s Stiff Solver Selection for Reaction and Kinetic Systems
- FFT Spectrum and Digital Filtering of Vibration Signals

Day 4: Simulink Dynamic Models, Control Loops and Optimisation

- Simulink Block Libraries, Signal Lines and Subsystem Structure
- Integrator and Transfer Function Blocks for First-Order Systems
- Simulink Solver Settings, Step Size and Algebraic Loops
- PID Controller Block Tuning Against Step Response Criteria
- fminsearch and fmincon Optimisation of Design and Tuning Parameters

Day 5: Lab: MATLAB Analysis and Simulink Model for a Case System

- Case System Brief for Tank Level or Motor Speed Loop
 - MATLAB Script Cleaning and Fitting the Case Test Data
 - Simulink Plant and PID Loop Build From Fitted Parameters
 - Model Validation Comparing Simulated and Measured Step Responses
 - Validated Engineering Analysis and Simulink Model Completion and Review
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Skills You Will Gain:

- Vectorised Programming
- Engineering Data Cleaning
- Regression Model Fitting
- Numerical Equation Solving
- Differential Equation Simulation
- Signal Filtering
- Block Diagram Modelling
- Control Loop Tuning

Why Attend This Course:

- Deliver a Validated Engineering Analysis and Simulink Model for a case system to the engineering lead and the control or process design team
- Decide whether a proposed controller setting or equipment change will meet its response target before it is tried on live plant
- Avoid repeated manual data cleaning, untraceable spreadsheet errors and trial-and-error tuning that disturb production
- Pass on reusable MATLAB functions, plot templates and Simulink model structures to engineering colleagues

Conclusion:

Back at work, the participant hands the engineering lead a Validated Engineering Analysis and Simulink Model that documents data preparation, fitted equipment parameters, the dynamic model and the comparison with measured responses. Process and control teams use it to test proposed set-point, tuning or equipment changes before they reach the plant, and to explain the expected effect to operations. After its first use, the unit should review how closely predicted responses matched the real equipment, which assumptions needed revision, and whether the scripts and model can serve as a template for other systems.

Frequently Asked Questions FAQ:

What should participants know before the MATLAB and Simulink for engineers course?

Participants should be comfortable with engineering mathematics, including basic calculus and matrices, and with reading plant or test data. No prior programming is required, though spreadsheet experience helps. Bringing an anonymised data extract from their own equipment makes the lab work more relevant.

How does MATLAB and Simulink for engineers differ from Python data analysis or process simulator courses?

This course centres on engineering calculation and dynamic modelling: numerical methods, ODE solving and Simulink control loops. Python data analysis courses focus on general analytics and machine learning, while process simulator courses build flowsheets with thermodynamic packages rather than custom equations.

Why is Simulink used with MATLAB when engineers model control loops?

Simulink represents a dynamic system as connected blocks such as integrators, transfer functions and PID controllers, which makes feedback structure visible and easy to change. MATLAB prepares the data, fits plant parameters and analyses simulated results, so both share variables in one workflow.

What do participants take back from the MATLAB and Simulink for engineers course?

Participants take back a Validated Engineering Analysis and Simulink Model for a case system, with data cleaning and curve fitting scripts, reusable functions, plot templates and a tuned PID loop model they can adapt to equipment in their own unit.
