MET-2550: ENGINEERING ANALYSIS USING MATLAB

Cuyahoga Community College

Viewing: MET-2550 : Engineering Analysis Using MATLAB

Board of Trustees:

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Academic Term:

Fall 2023

Subject Code

MET - Mech Eng/Manuf Ind Eng Tech

Course Number:

2550

Title:

Engineering Analysis Using MATLAB

Catalog Description:

Provide basic programming concepts and apply computational methodologies to solve engineering problems by emphasizing MATLAB interactive environment software. Particularly focused on matrix/vector computation, built-in MATLAB functions, numerical analysis, scientific and engineering graphics, m-files (source code), and introduction to visualization tools. Designed for people who may not have any previous MATLAB, computer or programming experience.

Credit Hour(s):

3

Lecture Hour(s):

2

Lab Hour(s):

2

Requisites

Prerequisite and Corequisite

MATH-1610 Calculus I, and highly recommend concurrent enrollment in MATH-1620 Calculus II.

Outcomes

Course Outcome(s):

Formulate computer algorithms and implement those algorithms in MATLAB to solve engineering problems.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

Objective(s):

a. Identify inputs, outputs, and variables of a given problem and write algorithms and flowchart to solve the problems.
b. Use procedural statements, assignments, conditional statements, loops, function calls--and arrays in solving problems.
c. Design, code, and test small MATLAB programs using MATLAB m-files to solve equation/problems.
d. Compute basic vectors and matrices.

Course Outcome(s):

Test and debug MATLAB programs.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

a. Understand, write, and debug MATLAB function files and script files to solve problems.
b. Design, code, and test small MATLAB programs using MATLAB m-files to solve equation/problems.
c. Use of different data files in MATLAB to solve problems.

Course Outcome(s):

Find solutions to engineering problems using standard numerical methods.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

a. Identify inputs, outputs, and variables of a given problem and write algorithms and flowchart to solve the problems.
b. Use procedural statements, assignments, conditional statements, loops, function calls--and arrays in solving problems.
c. Use MATLAB in-built functions for numerically solve engineering problems.
d. Understand and apply basic functions for numerical integration, differentiation, and curve fitting.
e. Use of different data files in MATLAB to solve problems.

Course Outcome(s):

Analyze the applicability and accuracy of numerical solutions to engineering problems.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

a. Identify inputs, outputs, and variables of a given problem and write algorithms and flowchart to solve the problems.
b. Understand, write, and debug MATLAB function files and script files to solve problems.
c. Use procedural statements, assignments, conditional statements, loops, function calls--and arrays in solving problems.
d. Use MATLAB in-built functions for numerically solve engineering problems.
e. Understand and apply basic functions for numerical integration, differentiation, and curve fitting.

Course Outcome(s):

Use MATLAB visualization tools to simulate and analyze engineering problems, present the output of computer programs in a scientific and engineering context, and document program outcomes in a clear and logical manner.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.
Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

Objective(s):

a. Use graphics tools in MATLAB to plot 2-D and 3-D graphs to visually present the output.
b. Use MATLAB report generator to document results of the engineering problem.
c. Use MATLAB Simulink to implement solution to multidisciplinary engineering problems and simulate processes.

Methods of Evaluation:
a. Weekly assignment
b. Written assignment
c. Quizzes
d. Mid-exam and Final exam

Course Content Outline:
a. Introduction to Engineering problem solving
    i. Engineering problem solving methodology
        1. Understand and sate the problem clearly and succinctly
        2. Identify inputs and outputs
    ii. Develop flowchart and write high-level algorithms to solve engineering problems
b. Introduction to MATLAB
    i. Getting used to the MATLAB environment
        1. Command window, docking and undocking windows
        2. MATLAB help
        3. MATLAB search path
    ii. Algorithms, Pseudo-code
    iii. Variables and data types
    iv. Logical operators
    v. Basis control structures IF, FOR, and WHILE loops
    vi. MATLAB m-files, function files, script files
    vii. Tracing a program/algorithm step-by-step
    viii. Debugging with breakpoints and print statements
c. MATLAB as a super-calculator
    i. Complex and real algebra
    ii. Matrix manipulation and Systems of linear equations
    iii. Trigonometry & Hyperbolic Trigonometry
    iv. Exponents & Logarithms Arrays and Matrices in MATLAB
d. MATLAM plotting
    i. Simple x-y plots
    ii. Multiple plots
    iii. Exploring plot as graphical image
    iv. Line color, line style, marker style, and legends
    v. Logarithmic scale
    vi. Explore 3-D plotting capability
        1. Contour, mesh and surface plots
e. Data modeling
    i. Linear regression
    ii. Optimization
    iii. Statistical analysis of data
    iv. Reading from and writing to different data files
    v. Curve fitting
f. Numerical Calculus
    i. Differentiation
    ii. Integration
g. Numerical modeling and simulation
    i. Initial value problem
    ii. Boundary value problem
    iii. Numerical stability and accuracy
h. Introduction to Simulink and Applications
    i. Simulink block library
    ii. Working with Sound
    iii. Working with Images

Resources

Attaway, Stormy. *MATLAB: A Practical Introduction to Programming and Problem Solving*. 4th edition. Elsevier, 2017.

Chapman, Stephen J. . *Essentials of MATLAB Programming.* 3rd Edition. Cengage Learning, 2018.

Figliola, Richard S., and Donald E. Beasley. *Theory and Design for Mechanical Measurements*. 7th ed. Wiley, 2020.

Karris, Steven. *Introduction to Simulink with Engineering Applications*. 3rd Edition. Orchard Publications, 2010.

Kirk, Franklyn W. , Thomas A. Weedon, and Philip Kirk. *Instrumentation and Process Cntrol*. 2019. American Technical Publishers, 2019.

Moore, Holly . *MATLAB for Engineers*. 6th edition. Prentice Hall, 2022.

Morris, Alan S. and Reza Langari. *Measurement and Instrumentation: Theory and Application*. 3rd ed*.* Academic Press, 2020.

Tse, Francis, Lynn Faulkner, and Ivan E. Morse. *Measurement and Instrumentation in Engineering Principles and Basic Laboratory Experiments*. 1st ed. CRC Press, 2018.

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