COURSE OUTLINE

ENES-271

Introduction to MATLAB

3 Semester Hours

HOWARD COMMUNITY COLLEGE

Description

This course is designed to introduce numerical methods to engineering students. Students will develop the skills to generate readable, compact, and verifiably correct MATLAB programs to obtain numerical solutions to a wide range of engineering models and to display the results with fully annotated graphics. Students will learn structured programming. Prerequisites: ENES-100 and MATH-150 or MATH-182. (2 hours lecture, 2 hours lab)

Overall Course Objectives

Upon completion of this course, the student will be able to:

1. Navigate MATLAB's interactive windows.
2. Use MATLAB's matrix-based instruction set.
3. Create fully annotated 2D and 3D graphs.
4. Solve numerical solutions to differential equations and integrals.
5. Employ conditional statements.
6. Import data to and from other applications.
7. Employ commands from several of MATLAB's toolboxes: Optimization, Simulink, Partial Differential Equations, Symbolic.

Major Topics

I. **Introduction**
   - A. Mathematical modeling
   - B. Numerical methods
   - C. Problem solving

II. **MATLAB fundamentals**
   - A. MATLAB Environment
   - B. Mathematical Operations
   - C. Use of Built-in Functions
   - D. Graphics

III. **Programming with MATLAB**
   - A. Data Input and Output
   - B. Structured Programming

IV. **Errors**
   - A. Round-off Errors
   - B. Truncation Errors
   - C. Model Errors and Uncertainty

V. **Roots of equations**
   A. Graphical Methods
   B. Bracketing Methods
   C. Bisection
   D. Fixed-Point Iteration
   E. Newton-Raphson
   F. Secant Methods
   G. MATLAB Functions: `fzero`

VI. **Linear algebraic equations and matrices**
   A. Matrix Algebra
   B. Solving simultaneous linear equations
   C. Gauss Elimination
   D. Lower Upper Decomposition
   E. Cholesky Decomposition
   F. MATLAB Left Division
   G. Matrix inverse and condition
   H. Iterative methods

VII. **Curve Fitting**
   A. Linear Least-Squares Regression
   B. Polynomial Regression
   C. Nonlinear Regression
   D. Splines

VIII. **Numerical Integration**
   A. Newton-Cotes
   B. Trapezoidal Rule
   C. Simpson's Rules
   D. Numerical Integration of Functions

IX. **Ordinary differential equations**
   A. Initial-Value Problems
   B. Adaptive Methods

X. **Eigenvalues**
   A. Mathematical Background
   B. Physical Background
   C. Polynomial Method
   D. Power Methods
   E. MATLAB Function: `eig`

Course Requirements

Grading/exams: Grading procedures will be determined by the individual faculty member but will be calculated on the basis of tests, lab reports, quizzes and final exams. This course includes a comprehensive final exam.

Writing: Specific writing assignments will be determined by the individual faculty member.