Engineering Models II

Last updated: 08/22/2014

Author Information

Dr. Kathleen Ossman
Dr. Gregory Bucks
 University of Cincinnati

Course Details

Description

Engineering Models II is a first-year undergraduate course that has also been taught as a dual-enrollment engineering program to hundreds of high school students.

This is the second in a unique series of interdisciplinary courses designed to develop good problem solving techniques and to illustrate how engineers use mathematics to solve a variety of practical and often complex problems. The course will closely track and directly apply fundamental theory from algebra, trigonometry, and calculus to relevant engineering applications chosen from a variety of disciplines. MATLAB® will be utilized as a programming and numerical computational tool to enable students to explore engineering concepts, to investigate solutions to problems too complex for hand solutions, and to develop an appreciation of the power and limitations of computer tools. Special attention will be given to graphical visualization of concepts and to numerical approximation techniques and the errors associated with approximations. This course includes a multi-week design project with students working in teams and presenting their solutions to other student teams.

Prerequisites

- Engineering Models I

Course Contents

Pre-Lecture Videos

A series of videos for the majority of course topics listed below are available.

Topic 1: User Defined Functions

- Lecture: User Defined Functions
- Lab: Resultant Force
- Problem Set: Assignment 1

Topic 2: Dataset Arrays

- Lecture: Introduction to Dataset Arrays
- Lab: CVG Airport Weather Statistics
- Problem Set: Assignment 2

Topic 3: Dataset Arrays (Con't)

- Lecture:
    - Big Data
    - Statistical Analysis and Data Presentation
- Lab: Delta Airline Departure Data

Topic 4: Symbolic Math Toolbox

- Lecture: Introduction to Symbolic Math Toolbox
    - Entering Expressions and Using Solve
    - Two-Link Robot Arm
- Lab: Two Link Robot Arm
- Problem Set: Assignment 3

Topic 5: Numerical Estimates for Derivatives

- Lecture: Introduction to Numeric Differentiation
- Lab: Estimating Velocity and Acceleration using Numerical Differentiation
- Problem Set: Assignment 4

Topic 6: Derivative Applications

- Lecture: Derivatives
    - Minimum/Maximum Examples
    - Newton Raphson Algorithm
    - Modeling Behavior of Physical Systems
    - Inductors

- - Crank - Rod - Piston
  - Modulation and FM Signals
- Lab: Newton Raphson Method for Solving Equations
- Problem Set: Assignment 5

Topic 7: [Numerical Integration](#)

- Lecture: Introduction to Numeric Integration
  - Visualizing Real-Time Integration
- Lab: Using Numerical Integration to Estimate Energy Usage
- Problem Set: Assignment 6

Topic 8: [Equation of Curves](#)

- Lecture: Finding Equations for Parabolas, Circles, Ellipses

Topic 9: [Integral Applications](#)

- Lecture: Integration Applications
- Lab: A Tale of Two (Velo) Cities
- Problem Set: Assignment 7

Topic 10: [Introduction to GUIS and Team Project](#)

- Lecture: Introduction to Graphical User Interfaces
- Project:
  - As a team design a graphical user interface using MATLAB that will help teach a fundamental concept to improve the quality of education received by future students

Topic 11: [Arc Length](#)

- Lecture: Integration Applications
  - Arc Length

Topic 12: [Center of Mass](#)

- Lecture: Integration Applications
  - First Moments, Center of Gravity, Centroid
- Problem Set: Assignment 8

Textbooks

[MATLAB: A Practical Introduction to Programming and Problem Solving](#), 3rd edition, Stormy Attaway, Elsevier, 2013 Ŧ

Ŧ *Supplemental Material*

Resources

[Cody](#): A program developed by MathWorks that allows students to progressively develop MATLAB® programming skills and earn badges in the process

Learn more about MathWorks academic resources:

[MATLAB Courseware](#)   [Hardware Resources](#)   [Classroom Resources](#)   [MATLAB Examples](#)   [Books](#)
[Tutorials](#)   [Webinars](#)   [Technical Articles](#)