Engineering Models I

Last updated: 08/27/2014

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Course Details

Description

Engineering Models I 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 first in a unique sequence 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 introduced and progressively developed as a programming 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. The course includes a two-week team project.

Prerequisites

- Algebra and trigonometry

Course Contents

Pre-Lecture Videos

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

Topic 1: Introduction to Course and MATLAB

- Lecture: Course Introduction
- Lab: Introduction to MATLAB

Topic 2: One Dimensional Arrays and Graphing

- Lecture: 1-d Arrays & Plotting
- Lab: Bits, Bytes, and Data Types
- Problem Sets:
    - Assignment 1
    - Assignment 2

Topic 3: Graphing and Curve Fitting

- Lecture: Curve Fitting
- Lab: Graphing Processes Modeled by Exponentials
- Problem Set: Assignment 3

Topic 4: Graphing and Interpolation

- Lecture: Interpolation
- Lab: Sinusoids and Simple Harmonic Motion
- Problem Set: Assignment 4

Topic 5: Input Statements and Good Programming Practices

- Lecture: Input/Output Statement Activities
- Problem Set: Assignment 5

Topic 6: Conditional Statements

- Lecture: Conditional Statements
- Lab:
    - Damped Sinusoidal Motion
    - Elliptical Machine Interface
- Problem Set: Assignment 6

Topic 7: Loops

- Lecture: For and While Loops
- Lab: Iterative Algorithms

- Problem Set: Assignment 7

Topic 8: Nested Loops and Break

- Lecture: Nested Loops and Breaks
- Lab: Convergence of Iterative Algorithms and Equations

Topic 9: Debugging

- Lecture: Debugging
- Lab: Debugging a Postal Code

Topic 10: Arrays

- Lecture: Arrays
- Lab: Introduction to Arrays
- Problem Set: Assignment 8

Topic 11: Array Operations and Useful Functions

- Lecture:
  - Min and Max Functions
  - Sum and Find Functions
  - Looping and Indexing
  - Blurring Filter
- Lab: Genome Indexing
- Problem Set: Assignment 9

Topic 12: Array Applications

- Lecture: Engineering Applications for Vectors & Matrices
  - Solving Linear Equations using Arrays
  - Mechanics
  - Circuit Analysis
- Lab: DNA Pattern Matching
- Problem Set: Assignment 10

Project

Team Project: Grand Challenges

As a team download UN datasets and generate user-friendly script file(s) for processing the data. The script file(s) must cover 7 out of the 9 lecture topics from class.

Textbooks

MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013 ₸

₸ *Supplemental Material*

Resources

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