ENGR 0220 - PROGRAMMING AND PROBLEM SOLVING IN ENGINEERING

Catalog Description

Prerequisite: Completion of MATH 30 and PHYS 205 and 205L with grades of "C" or better
Advisory: PHYS 205 may be taken concurrently
Hours: 108 (54 lecture, 54 laboratory)
Description: Utilizes the MATLAB environment to provide students with a working knowledge of computer-based problem-solving methods relevant to science and engineering. It introduces the fundamentals of procedural and object-oriented programming, numerical analysis, and data structures. Examples and assignments in the course are drawn from practical applications in engineering, physics, and mathematics. (C-ID ENGR 220) (CSU, UC)

Course Student Learning Outcomes

- CSLO #1: Apply a top-down design methodology to develop computer algorithms.
- CSLO #2: Apply numeric techniques and computer simulations to analyze and solve engineering-related problems.
- CSLO #3: Implement MATLAB effectively to analyze and visualize data.
- CSLO #4: Create, test and debug sequential MATLAB programs, as well as programs that use object-oriented techniques, in order to achieve computational objectives.
- CSLO #5: Create, format, and program data sets into structural arrays to solve standard engineering problems using course software.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

108

Outside of Class Hours

108

Total Student Learning Hours

216

Course Objectives

Lecture Objectives:
1) Demonstrate proficiency with the MATLAB environment and functions;
3) Create user defined functions, inputs and outputs;
4) Define engineering problems within MATLAB Software;
5) Create and manipulate matrices within MATLAB software that model engineering problems (physical phenomena);
6) Create (program) logical functions, selection structures, and repetition structures;
6) Perform matrix algebra with MATLAB to solve engineering problems;
7) Perform symbolic mathematics with MATLAB to simulate engineering problems;
8) Use advanced numerical techniques with MATLAB to simulate engineering problems;
9) Distinguish between variables, constants, and controls;
10) Use the MATLAB software to obtain graphical solutions for engineering problems;
Laboratory Objectives:
1)Create a top-down design methodology to develop computer algorithms.
2) Write, test and debug sequential Matlab programs, as well as programs that use object-oriented techniques, in order to achieve computational objectives.
3)Synthesize numeric techniques and computer simulations to analyze and solve engineering-related problems.
4)Create a MATLAB program to effectively analyze and visualize (display) data.
5)Create and use standard data structures within a MATLAB software program.

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Objective Examinations
  - Example: 1. In class, create a simple MATLAB program to solve for the position (x,y,z) of a rocket over time (t), given several initial conditions and thrust behavior. 2.In class, write a MATLAB program to create an inches vector from 0 - 120 with increments of 10, then calculate the corresponding values of feet, and then group the inch vector and feet vector together into a table matrix.
- Projects
  - Example: In a group, create several MATLAB programs to accept input data, then model behavior based upon engineering principals, and finally create a graphical output of the results: Example 1. Write a program to model the behavior of a four-bar mechanism, with min and max dimensions, in two dimensional space, that is connected by pins and allowed to rotate. Show a graphical output of this mechanism in motion. Rubric Grading. Example 2: Use MATLAB to simulate and then solve a statics problem of a simple frame (truss) under an applied load. Use MATLAB to optimize the geometry of the frame to maximize the applied load without breaking the frame.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Hands-on group computer activity based on the lecture. For example, have each group create a program using MATLAB. Tasks would be design, coding, and debugging of an engineering problem. The topic for the hands-on activity is chosen to reinforce the lecture and to prepare them for the homework assignment. This will normally be the optimization of some output variable by adjusting several of the input variables.

Lecture:

1. Lecture slide presentation interspersed with topic-specific video clips and live demonstrations of programming techniques. For example, the lecture topic might be programming inputs and outputs. First, review background, general terminology, and a step by step procedure using PowerPoint. Second, do a live demonstration on creating a program utilizing several different formatted data inputs. Third, assign students a new program to write that utilizes the same techniques, but is a completely different problem than the demonstration.

Distance Learning

1. Instructor illustrates creating and manipulating matrices within MATLAB software via live/recorded video and posts an online discussion.

Typical Out of Class Assignments
Reading Assignments

1. Read the assigned pages from the textbook on programming and matrix algebra operations and be prepared to discuss and solve engineering problems that include multiple constraint equations. 2. Read the assigned pages from the textbook on MATLAB user defined input variables and be prepared to discuss their use and how to program those input variables.

Writing, Problem Solving or Performance

1. Complete several of the problems at the end of the chapter related to creating and manipulating matrices. These problems will then be graded by an instructor with a standardized rubric in accordance with correct solutions and accepted best practices for programming. 2. Complete problem sets at the end of the chapter on formatting output to a desired representation. Turn in plots with said output to the instructor and have them evaluated (graded).

Other (Term projects, research papers, portfolios, etc.)
Required Materials

- MATLAB for Engineers
  - Author: Holley Moore
  - Publisher: Pearson
  - Publication Date: 2017
  - Text Edition: 5th
  - Classic Textbook?:
  - OER Link:
  - OER:
- MATLAB: An Introduction with Applications
  - Author: Amos Gilat
  - Publisher: Wiley
  - Publication Date: 2017
  - Text Edition: 6th
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

Computer storage device (Flash drive)