COURSE OUTLINE : ENGR 156
D Credit – Degree Applicable
COURSE ID 010214
Cyclical Review: February 2020

COURSE DISCIPLINE : ENGR

COURSE NUMBER : 156

COURSE TITLE (FULL) : Programming and Problem-Solving in MATLAB

COURSE TITLE (SHORT) : Program & Prob Solv in MATLAB

CALIFORNIA STATE UNIVERSITY SYSTEM C-ID : ENGR 220 - Programming and Problem-Solving in MATLAB

CATALOG DESCRIPTION

ENGR 156 provides an introduction to MATLAB to provide students with a working knowledge of computer based problem-solving methods with applications for science and engineering. It introduces the fundamentals of procedural and object-oriented programming, numerical analysis, and data structures. Students gain experience working with MATLAB toolboxes and with development and debugging of programs using MATLAB and Simulink. Examples and assignments in the course are drawn from practical applications in engineering, physics, and mathematics.

Total Lecture Units: 2.00

Total Laboratory Units: 1.00

Total Course Units: 3.00

Total Lecture Hours: 36.00

Total Laboratory Hours: 54.00

Total Laboratory Hours To Be Arranged: 0.00

Total Contact Hours: 90.00

Total Out-of-Class Hours: 72.00

Prerequisite: MATH 103E or equivalent.

ENTRY STANDARDS

	Subject	Number	Title	Description	Include
1	MATH	103E	Calculus and Analytic Geometry	find limits of functions at real values and at infinity using numerical, graphical, and algebraic approaches;	No
2	MATH	103E	Calculus and Analytic Geometry	determine and prove continuity and differentiability of a function at a real value;	No
3	MATH	103E	Calculus and Analytic Geometry	find the derivative of a function as a limit;	Yes
4	MATH	103E	Calculus and Analytic Geometry	use the derivative for rate of change problems;	No
5	MATH	103E	Calculus and Analytic Geometry	find the equation of a tangent line to a function at a point;	No
6	MATH	103E	Calculus and Analytic Geometry	compute derivatives using differentiation formulas: constants, power rule, product rule, quotient rule and chain rule. Calculate higher order derivatives;	No
7	MATH	103E	Calculus and Analytic Geometry	use differentiation to solve applications such as related rate problems and optimization problems;	Yes
8	MATH	103E	Calculus and Analytic Geometry	use implicit differentiation with applications, including in differentiation of inverse functions;	No
9	MATH	103E	Calculus and Analytic Geometry	find derivatives of transcendental functions: trigonometric, exponential, logarithmic, and others;	Yes
10	MATH	103E	Calculus and Analytic Geometry	determine relative and absolute maximum and minimum points of functions and points of inflection;	No
11	MATH	103E	Calculus and Analytic Geometry	graph functions using the methods of calculus;	No
12	MATH	103E	Calculus and Analytic Geometry	use the Mean Value Theorem;	No
13	MATH	103E	Calculus and Analytic Geometry	evaluate a definite integral as a limit of Riemann sums;	No
14	MATH	103E	Calculus and Analytic Geometry	apply integration to find areas, apply properties of integrals;	Yes
15	MATH	103E	Calculus and Analytic Geometry	evaluate antiderivatives and indefinite integrals;	No
16	MATH	103E	Calculus and Analytic Geometry	evaluate integrals using the Fundamental Theorem of Calculus;	No
17	MATH	103E	Calculus and Analytic Geometry	use substitution to integrate;	No
18	MATH	103E	Calculus and Analytic Geometry	apply l'Hospital's rule to find limits of indeterminate forms.	No

EXIT STANDARDS

1 write M-files to calculate functions over a range of values;
2 plot functions f(x) including signals such as pulse trains;
3 perform basic matrix operations such as multiplication, transposition, and the use of inverse matrices to solve linear equations;
4 write M-files to do basic matrix operations as well as branching statements such as switch and case;
5 write M-files with “while” and “for” loops and user defined functions;
6 calculate with complex numbers including complex exponentials;
7 write M-files with complex data and string functions including calculations using Euler’s relation;
8 write simple graphical user interfaces;
9 setup and analyze basic engineering problems using MATLAB and Simulink;
10 describe the usage of some of MATLAB’s toolboxes.

STUDENT LEARNING OUTCOMES

1 apply a top-down design methodology to write pseudocode and transform it into a functioning program for a science or engineering application
2 create code to solve tasks or problems and evaluate their viability using defined testing methods
3 use MATLAB to analyze and visualize data

COURSE CONTENT WITH INSTRUCTIONAL HOURS

	Description	Lecture	Lab	Total Hours
1	Introduction • Overview of computer systems • Introduction to MATLAB • How MATLAB is used in industry • Engineering problem solving techniques • Brief history of computer programming and engineering software tools	2	0	2
2	MATLAB Environment • MATLAB windows • Solving problems with MATLAB • Variables, expressions and order of operation • Array definitions and operations • Vector analysis • Solving equations of one variable	3	3	6

3	Built-In MATLAB Functions • Elementary functions • Trigonometric functions • Data analysis functions • Random and complex numbers • Sorting and searching functions • Computational limits	3	3	6
4	Manipulating Matrices and Plotting • Defining matrices • Solving problems with two variables • Special matrices • Plotting overview • Two dimensional plots and subplots • Three dimensional plots	4	5	9
5	User Defined Functions • Computational problem-solving methodology • Creating function M-files • Creating toolbox of functions • Anonymous functions, function handles, functions, and sub functions • Recursive functions	4	5	9
6	User Controlled Input and Output • User defined input and output options • Graphical input • Formatting input and output • Reading and writing data from files • Debugging code	4	5	9
7	Logical Functions and Selection Programming Structures • Relational and logical operators • Flowcharts and pseudocode • Documentation • Logical functions • Selection structure • Debugging	3	6	9
8	Repetition Structures and Matrix Algebra • For loops, while loops, break and continue, midpoint loop, nested loops and improving • the efficiency of loops • Matrix operations and functions • Solution of systems of linear equations • Special matrices	3	6	9

9	Arrays and Symbolic Mathematics • Data types, multidimensional arrays, character arrays, cell arrays and structure arrays • Object oriented programming • Introduction to data structures • Symbolic algebra, solving expressions and equations, symbolic plotting and calculus • Solving ordinary differential equations	3	6	9
10	Numerical Techniques and Advanced Graphics • Interpolation, curve fitting, least squares regression and linearization • Using interactive fitting tools, • Differences and numerical differentiation and numerical integration • Series approximation and error • Optimization • Images, handle graphics, animation, other visualization techniques and introduction to volume visualization	3	6	9
11	Graphical User Interface (GUI) • Simple GUI with one user interaction • GUI with multiple user interaction • Built in GUI templates	3	6	9
12	Simulink • Introduction and application • Solving differential equations	1	3	4
				90

OUT OF CLASS ASSIGNMENTS

1 programming assignments (e.g. design/develop an object oriented program);
2 laboratory assignments related to the course content (e.g. plotting global positioning system, GPS, data in X,Y coordinates) or (e.g. given a set of finite difference equations solve for the temperature distribution on a flat plate);
3 individual and/or group projects (e.g. develop software for engineering, mathematical, and scientific applications).

METHODS OF EVALUATION

1 programming assignments;
2 quizzes;
3 exams;
4 laboratory assignments;
5 final project;
6 final exam.

METHODS OF INSTRUCTION

- [x] Lecture
- [x] Laboratory
- [ ] Studio
- [ ] Discussion
- [x] Multimedia
- [ ] Tutorial
- [ ] Independent Study
- [x] Collaboratory Learning
- [ ] Demonstration
- [ ] Field Activities (Trips)
- [ ] Guest Speakers
- [ ] Presentations

TEXTBOOKS

Title	Type	Publisher	Edition	Medium	Author	IBSN	Date
MATLAB for Engineers	Required	Upper Saddle River: Prentice Hall	5	Print	Moore, Holly	0-13-978-0134589640	2018
MATLAB Programming for Engineers	Required	Boston: Cengage		Print	Chapman, Stephen J.	1111576718	2016