Beni Suef Technological University

Programming for Mechatronics Applications Syllabus

Syllabus

Course Title: Programming for Mechatronics Applications

Course Code: N/A

Course Followers: Students of Mechatronics Department in 2nd year of 1st semester

Course Meeting Times

Labs: 1 session / week, 4 hours / session

Course Credits: 3

Course Introduction

This course unit aims at giving the students with the programming competency not in the traditional coding domain such as C-coding but in computing coding such as MATLAB m-file or graphical coding in Simulink workspace. Also, this course aims to train student how to handle easily matrix-based computation and functions such as drawing functions and data, and algorithm implementation through programming will be taught using MATLAB/Simulink software. The main contents include: MATLAB language, Simulink representation, vector and matrix computing, algebraic/differential equations, coordinates transformation, graphic representations of data and signals, etc.

Course Objectives

After successfully studying this course, students will learn: How to solve Vectors and matrices.

1. Apply Scalar and array operations on vectors and matrices.
2. Write scripts to produce and customize simple plots.
3. Solve Linear and None Linear Algebraic Equations.
4. Perform mathematical operations with matrices.
5. Solve MATLAB functions that operate on arrays of data.
6. Solve Ordinary Differential Equations.

Learning Outcomes

1. Understand the basic principles of Computing Languages such as MATLAB/Simulink
2. Master computing / analyzing numerically for some Mechatronics problems by using programming language
3. Compute and express some solutions graphically.

Prerequisites

Student Should Pass the following Courses

1. Mathematics for Technicians (1st year,1St Semester)

2. Application of Math and Science in Technology (1st year,1st Semester)

Textbooks

The course textbooks are:

1. Stormy Attaway, MATLAB - A Practical Introduction to Programming and Problem-Solving 4th Ed, Elsevier Inc.,2017.
2. Edward B. Magrab et al, An Engineer's Guide to MATLAB® With Applications from Mechanical, Aerospace, Electrical, Civil, and Biological Systems Engineering Third Edition, Prentice Hall, 2011.
3. Svein Linge,Hans Petter Langtangen, Programming for Computations - MATLAB/Octave: A Gentle Introduction to Numerical Simulations with MATLAB/Octave (Texts in Computational Science and Engineering (14)) 1st ed. Edition, Springer, 2016.

Labs (or Tutorials/Exercise, Workshop)

- Labs will be conducted during the weeks shown in the schedule. Each lab assignment involves one or more accomplishments which must be checked off by an instructor in the lab. The instructor will be available for help and lab check-off during those weeks in which a lab is in progress.
- Students must successfully complete a series of lab assignment works throughout the course. The instructor will gather a collection of work that demonstrates evidence of a range of techniques in this course.
- Lab assignments must be done on your own. Skipping the lab and submitting work copied from someone else is a serious breach of ethics, and will be handled by the Committee on Discipline.
- Lab assignments will be graded on a scale of 0 to 3 (3: lab complete, works, good job on pre- and post-lab; 2: lab mostly complete, reasonable job on pre and post lab; 1: lab partially done, marginal to poor job on pre- and post-lab; 0: lab not done, poor job on pre- and post-lab).

Lab Books

- You must obtain the contents of a few pages for every lab (from Lab #1 to lab #14) for recording measurements, observations and graphs of data taken during the in-lab exercises.
- Written pre-lab and post-lab exercises are also to be completed in your own papers.

Midterm Exam

·One midterm exam for testing the learning outcomes will be given in this term. The exam will take place few days after Lab #7 for a four-hour duration.

·Students have to demonstrate that the learning outcomes from Lab #1 to Lab#7 have been achieved.

Final Exam

· A four-hour final exam will be given during the end-of-term exam week.

· Students have to demonstrate that the learning outcomes from Lab activities after the midterm exam had been achieved.

Calendar

The calendar provides information on the course's lecture class (L), lab (Lab #), and exam (E) sessions.

SES #	TOPICS	KEY DATES
Lab #1	Introduction to MATLAB	Lab report #1 in
Lab #2	Numerical expressions	Lab report #1 out Lab report #2 in
Lab #3	Vectors and matrices	Lab report #2 out Lab report #3 in
Lab #4	Operations on vectors and matrices	Lab report #3 out Lab report #4 in
Lab #5	Writing Script Using MATLAB	Lab report #4 out Lab report #5 in
Lab #6	Scripts to customize simple plots- file input/output (load and save)	Lab report #5 out Lab report #6 in
Lab #7	The if statement -The if else statement	Lab report #6 out Lab report #7 in
E1	**Mid Term Exam**	
Lab #8	Matrix Properties- Linear Algebraic Equations	Lab report #7 out Lab report #8 in
Lab #9	Addition and subtraction- Multiplication- Determinants	Lab report #8 out Lab report #9 in
Lab #10	Matrix inverse- Solution of a system of equations	Lab report #9 out Lab report #10 in
Lab #11	MATLAB functions that operate on arrays of data	Lab report #10 out Lab report #11 in
Lab #12	Solving Ordinary Differential Equations	Lab report #11 out Lab report #12 in

SES #	TOPICS	KEY DATES
Lab #13	Solving Nonlinear Algebraic Equations	Lab report #12 out Lab report #13 in
Lab #14	Rate of Convergence- Solving Multiple Nonlinear Algebraic Equations.	Lab report #13 out Lab report #14 in
E2	**Final Exam**	

Grading (or Assessment) Policy

Initial grading will be based on the following weighting:

ACTIVITIES	PERCENTAGES
Labs (performance & reports)	60%
Midterm	20%
Final exam	20%

- Lab assignments will be graded on a scale of 0 to 3
  - i) 3: lab complete, works, good job on pre- and post-lab;
  - ii) 2: lab mostly complete, reasonable job on pre and post lab;
  - iii) 1: lab partially done, marginal to poor job on pre- and post-lab;
  - iv) 0: lab not done, poor job on pre- and post-lab.

- Midterm & Final Exam will be grade on a scale of 0 to 3 according to the degree of achievement in each learning outcome.
  - i) 3: complete achievement in learning outcome;
  - ii) 2: mostly complete, reasonable achievement in learning outcome;
  - iii) 1: partially done, marginal to poor achievement in learning outcome;
  - iv) 0: not done, poor achievement in learning outcome.

Lecture notes

This section contains lab notes from every chapter of the practice manual, "1. Farag Ragab, Pneumatics and Hydraulics (Practice Manual), BST, 2020"

LEC #	TOPICS	LECTURE NOTES (BOOK I FOR L1 TO L12 & BOOK II FOR L13)
L1	Introduction to MATLAB	Module 1
L2	Relational expressions	Module 1
L3	Vectors and Matrices	Module 2
L4	Vectors and Matrices	Module 2
L5	Introduction to MATLAB Programming	Module 3
L6	Writing Scripts	Module 3
L7	Selection Statements	Module 4
L8	Advanced Mathematics	Module 5
L9	Mathematical operations with matrices (Addition and subtraction- Multiplication-Determinants)	Module 6
L10	MATLAB functions that operate on arrays of data (Matrix inverse- Solution of a system of equations)	Module 6
L11	MATLAB functions that operate on arrays of data	Module 7
L12	Solving Ordinary Differential Equations	Module 8
L13	Solving Nonlinear Algebraic Equations	Module 9

Lab notes (or Practice Manual)

This section contains lab notes from every chapter of the practice manual,

LAB #	TOPICS	LAB NOTES (PRACTICE MANUAL CHAPTER)
Lab #1	Introduction to MATLAB	Module 1 (Lab#1)
Lab #2	Relational expressions	Module 1 (Lab#2)
Lab #3	Vectors and Matrices	Module 2 (Lab#3)
Lab #4	Logical vectors- Matrix multiplication	Module 2 (Lab#4)
Lab #5	Algorithms- MATLAB scripts- Input and output	Module 3 (Lab#5)
Lab #6	Writing Scripts	Module 3 (Lab#6)
Lab #7	The if statement -The if else statement	Module 4 (Lab#7)
Lab #8	Advanced Mathematics Matrix Properties- Linear Algebraic Equations	Module 5 (Lab#8)
Lab #9	Mathematical operations with matrices	Module 6 (Lab#9)
Lab #10	Mathematical operations with matrices	Module 6 (Lab#10)
Lab #11	MATLAB functions that operate on arrays of data	Module 7 (Lab#11)
Lab #12	Solving Ordinary Differential Equations	Module 8 (Lab#12)
Lab #13	Brute Force Methods- Newton's Method- The Secant Method- The Bisection Method.	Module 9 (Lab#13)
Lab #14	Rate of Convergence- Solving Multiple Nonlinear Algebraic Equations	Module 9 (Lab#14)