جامعة الحسين التقنية
Al Hussein Technical University

ASSIGNMENT BRIEF

HTU Course No: 00103101 BTEC UNIT No: N/A	HTU Course Name: STEM 1 LAB BTEC UNIT Name: N/A

For use with the following qualifications:

- HTU Technical Degree in Engineering
- HTU B.Sc. Degree in Engineering

Assignment Brief Number: 2

Version 1

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Assignment Brief

Student Name/ID Number/Section	
BTEC Unit Number and Title	N/A
HTU Course Number and Title	00103101: STEM 1 Lab
Academic Year	Fall 2021/2022
Assignment Author	Eng. Heba Jaradat and Eng. Nadia alsaad
Course Tutor	Eng. Rasha Shaheen, Eng. Mohammad AL-Fayyad, Eng. Nadia Alsaad, Eng. Heba Jaradat
Assignment Title	Numerical Solution of Mathematically Modelled STEM problems.
Assignment Ref No	Assignment #2-Part One
Issue Date	17 January, 2022
Formative Assessment dates	17-1 February, 2022
Submission Date	2 February, 2022
IV Name & Date	Dr. Mohammad Abdel-Rahman, 16 January, 2022

Submission Format

This is the part 1 of the second assignment of STEM 1 Lab, which is a take-home activity. The submission should be provided by **uploading a compressed folder to eLearning**, the folder should include the following:

1. A well-organized report following the technical report style in pdf. The answers need to follow clear and coherent steps. Final answers without detailed steps are not accepted.
2. 2-One MATLAB file for all tasks (.mfile) and Simulink file (.SLX).

There might be a selective oral session with your assessor as part of the evaluation.

General Guidelines

- If plagiarism is detected, the students' mark will be "Unclassified".
- The soft-copy of the assignment must be in pdf format.
- The report should be typed using a computer, not handwritten.
- Your report should be neat and organized in orderly manner, with proper page numbering and task numbering.

Final report requirements:

1. Your final submitted report should be a **single file in PDF format**.
2. The front page should include the course name, your section, assignment name, your name and student ID, HTU LOGO, and your tutor name.
3. Whenever you are asked to write a MATLAB code, make sure that you include your code in the report,

comment your code to show your steps, and explain them.

4. The font for the code must be courier new; readable and the comments colored in green.
5. The final report should be concise **(15 pages maximum).**
6. Remember, the objective of the assignment is to assess understanding rather than the ability to simply reproduce analytical procedures and this requires you to explain the steps in your analysis.
7. Whenever plots are required, make sure to include them within your report, assure that all your figures/plots are well labelled and numbered in the report.
8. The soft-copy of the assignment must be included in the compressed file and submitted to Moodle, the pdf file name must be as follows: Student Name_Student ID.pdf.

Unit Learning Outcomes

LO 3 Numerically solving and simulating mathematically modelled STEM problems.

Assignment Brief and Guidance

Task I

You are working as a site engineer in NEPCO. Your colleague asked you to prepare a report related to the electricity bills in a small neighbourhood in Amman. The electricity bills of residents are calculated as follows:

- If 500 units or fewer are used, the cost is 0.02 JOD per unit.
- If more than 500 but not more than 1000 units are used, the cost is 0.02 JOD per unit for the first 500 units and 0.05 JOD for every unit in excess of 500.
- If more than 1000 units are used, the cost is 0.035 JOD per unit for the first 1000 units and 0.07 JOD for every unit in excess of 1000.
- A basic service fee of 5 JOD is charged, no matter how much electricity is used.

A. Draw the flow chart for a system that calculates and displays the cost for electric bill of a resident with known consumption units.
B. Following are the consumptions (units) for a number of residents: 200, 450, 501, 1010, 85, 700. Write a program that enters the previous consumptions into a vector then:
   I. Use a “for” loop to calculate and display the total cost for each resident.
   II. Use a “while” loop to calculate and display the total cost for each resident.

Task II

As a senior member of a well-known company, you have been asked to analyze, check and evaluate the output of many codes. The following two codes form a small part of your task:

Code 1:

```
v = [3   1   5];
i = 1;
for r = 1: length(v)
    j=v(r);
    i = i + 1;
    if i == 3
        i = i + 2;
        m = i + j;
    end
end
```

- Code 2:

```
n = input( 'Number of terms?' );   % n = The last digit of  your ID (1st digit from the right) +5
s = 0;
for k = 1:1:n
    s = s + 1 / (k ^ 2);
end;
g=sqrt(6 * s);
disp(sqrt(6 * s))
```

A. Draw up a table of the values of i, j, k and m to show how they change while the script executes for both codes.
B. Work out by hand the value of each variable in both codes after each iteration.
C. Check your answers by running the script.
D. Now rewrite the script of code 2 using vectors and array operations (without using "for" or "while" loop). Then, comment on your answer.

Parts D, E and F are based on code 2 only:

E. In code 2; Assume that "n" could take any positive integer value larger than 50, and critically compare between the methods of finding "g" by:
   i. running the script as it is (part C), and,
   ii. using the method in part D.

F. In code 2; Assume that "n" is the last digit of your ID (if the last digit =0, replace it with 3); but the increment of the "for loop" in code 2 is changed to 0.5; in this case modify the code in part D to find the same value of "g", and then critically compare between the methods of finding "g" by:
   i. running the script as it is (part C), or:
   ii. using the method in part D.

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Task III

You are working in HTU as a math tutor. One of your students gives you one unknown variable (y) that can be computed using the following series:

$$y = 8 * \left(\frac{1}{1 \times 3} + \frac{1}{5 \times 7} + \frac{1}{9 \times 11} + \cdots\right)$$

A. Write a program to compute y using this series.

   Use as many terms as you can (start modestly, with 5 terms, say, and re-run your program with more and more each time, display the number of terms used each time).

B. If you run this script for larger number of terms, you will find that the output approaches a well-known value. Can you figure out what it is?

C. Compare the numerical results obtained from part B for different numbers of iterations.

D. Plot the value of y with respect to each iteration with the appropriate title, labels, and legend. Comment on your answer.

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Task IV

Suppose you are working as a sales engineer at MBC. The manager of the channel asked you to carry out research about a case study methodology and advertising media sales data processing, to measure the causal effects of offline advertising on sales, before developing an innovative realistic predictive method to predict the sale size.

After collecting the appropriate data from different sectors, you found that the average size of the sales based on the type of advertisement is as shown in the following table:

Advertisement Type/Month	January	February	March	April	May	June	July
TV	230.1	44.5	17.2	151.5	180.8	8.7	57.5
Newspaper	69.2	45.1	69.3	58.5	58.4	75	23.5
Radio	37.8	39.3	45.9	41.3	10.8	48.9	32.8

The head of sales department asked you to write a MATLAB code that accomplishes the following tasks:

A. Build a 2-dimensional matrix, "sales", that includes the average size of the sales in each month from January to July, for each advertisement type.
B. Using "for" loop, find and display the value of the highest sales for each type and point out at which month.
C. Using while loop, display the value of the highest sales for each month and point out the related advertisement type.
D. A certain tax will be paid per month, based on the size of the sales at that month. If the sale size is larger than 50 and no more than 100, then 200 JOD will be paid. If the sale size is larger than 100 and no more than 185, then 350 JOD will be paid. Otherwise, the tax is 500JOD. Based on that, build a matrix to explain the tax amount and call it "Tax".
E. Round each element in the "Sales" to an integer, and store them in a matrix with the name of "rounded_sales".
F. According to matrix "rounded_sales", display the number of months that achieved an even value of sales for all categories.
G. Describe and display the data of TV advertisements of each month qualitatively. For sales larger than 100, print "High" otherwise, print "low".

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Task V

You are working at HTU as a math tutor. One of your students asked you to solve the following set of linear equations, using both "inverse matrix method" and "feedback system method", knowing that you only have **Simulink available for this task.**

$$X - 2 + y + z = 0$$

$$-4y + 6x + 5z = 31$$

$$5x + 2y + 2z = 13$$

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Task VI

You work as a service engineer at a factory, the factory is composed of multiple floors, and contains two elevators.

At some point elevator 1 was 5.5m above the ground and began moving down at speed of $(0.5080m/sec)$, at the same time elevator 2 was 1.2m above the ground and began moving upwards at speed of (0.7620m/sec).

You are required to perform the following tasks:

a) Mathematically model the height of elevator 1 (y1) with respect to time (t) and name this equation "equation 1", also, mathematically model the height of elevator 2 (y2) with respect to time (t) and name this equation "equation 2".
b) Write a Matlab code that plots both equation 1 and equation 2 on the same set of axes, use a proper grid, legend, axis labels and title.
c) From the plot in part b, find at what time and height the elevators will cross each other's path.
d) Write a Matlab code which calculates at what time and height the elevators will cross each other's path.
e) Apply the "feedback system method" available in Matlab Simulink to find at what time and height the elevators will cross each other's path.
f) Critically compare between multiple numerical solutions which you found at parts c, d and e.

Learning Outcomes and Assessment Criteria			
Learning Outcome	**Pass**	**Merit**	**Distinction**
LO 3 Numerically solving and simulating mathematically modelled STEM problems	**P4** Draw a proper flow chart for real STEM problems. **P5** Compute a mathematical operation repeatedly using proper MATLAB commands. **P6** Use Simulink to solve a set of linear equations following the inverse matrix method.	**M4** Use Simulink to solve a set of linear equations following multiple techniques. **M5** Develop an efficient searching algorithm for a real STEM problem.	**D3** Critically compare between script-based and Simulink-based models of a real STEM problem.

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STUDENT ASSESSMENT SUBMISSION AND DECLARATION

When submitting evidence for assessment, each student must sign a declaration confirming that the work is their own.

Student name and No.:	Assessor name:	
Issue date: **17/1/2021**	Submission date:	Submitted on:
Programme:		
BTEC Course Number and Title:**: NA** HTU Course Number and Title : 00103101: STEM 1 Lab		
Assignment number and title: Assignment #1-Part One: Manipulating, processing, and visualizing data using computer software and Mathematical Modelling		

Plagiarism

Plagiarism is a particular form of cheating. Plagiarism must be avoided at all costs and students who break the rules, however innocently, may be penalised. It is your responsibility to ensure that you understand correct referencing practices. As a university level student, you are expected to use appropriate references throughout and keep carefully detailed notes of all your sources of materials for material you have used in your work, including any material downloaded from the Internet. Please consult the relevant unit lecturer or your course tutor if you need any further advice.

Student Declaration

Student declaration

I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.

Student signature: **Date:**

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