The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc. / B. Ed. Degree Programme

Department	**: Mathematics**
Level	**: 05**
Name of the Examination	**: Final Examination**
Course Title and - Code	**: Introduction to MATLAB programming – ADU5320**
Academic Year	**: 2023/24**
Date	**: 08.04.2024**
Time	**: 09.30a.m. –11.30a.m.**
Duration	**: Two Hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This paper consists **FOUR (04) pages**.
3. **This paper consists of TWO sections: Section A and Section B.**

Section A

- o This section is compulsory
- o It consists of FIVE(05) Structured Essay Questions
- o Each question carries 20 marks.
- o Provide answers in the given space under each question.

Section B

- o This section consists of FIVE(05) Essay Type Questions and each question carries 100 marks.
- o Answer only any THREE(03) questions of them in a separate answer booklet given by the University .
- o Answer for each question should commence from a new page.

4. Answer for each question should commence from a new page.
5. Involvement in any activity that is considered as an exam offense will lead to punishment.
6. Use blue or black ink to answer the questions.
7. Clearly state your index number in your answer script.

PART A

1. a) Write the code to define the variables x and y as $x = 6.5$ and $y = 3.8$, and then evaluate the value of the following expression into MATLAB command window:

   i) $(x^2 + y^2)^{2/3} + \frac{xy}{y-x}$

   ii) $\frac{\sqrt{x+y}}{(x-y)^2} + 2x^2 - xy^2$

   b) Consider the following MATLAB code.

```
for i=1:4
    for j=1:4
        a=5;
        a=a+5;
    end
end
a
```

   Write the output of the above code. Briefly explain your answer.

   c) Write a MATLAB command to plot $y = \sin x$ and $y = \cos x$ on the same graph for values of x defined by $x = 0{:}\frac{pi}{30}{:}2 * pi$. Write commands to label x and y axis and to add a title to the graph.

   d) Write a MATLAB code to find the following.

   i. $\lim_{x\to 0^-} \frac{e^{x^3-1}}{1-\cos\sqrt{x-\sin x}}$

   ii. $\lim_{x\to 0}[\lim_{y\to 0} \frac{x^2+y^2}{\sqrt{x^2+y^2+4}-2}]$

   e) Two functions $f(x) = 2x^2 - x + 2$ and $g(x) = 3x^3 - 8$, satisfy the product rule $(f \cdot g)' = f' \cdot g + f \cdot g'$. Write a MATLAB program to verify the results.
   (**Hint**: Use if else statements).

PART B

1. a) Write a script of a MATLAB function to draw a circle of a specified radius, with the radius as the input to the function.

   b) Write a MATLAB program to compute and display the sum of the first 10 terms of the series

   $$14k^3 - 20k^2 + 5k. k = 1,2,3 \ldots$$

2. a) Student grades are to be assigned as follows:

   A 80% - 100%

   B 65%-79%

   C 50%-64%

   Write a MATLAB program to input a mark and display the appropriate grade. If the user enters a number greater than 100 or less than zero, display a message that the mark is invalid.

   b) Write a MATLAB program to calculate the *area* enclosed between the x- axis, and the curve $y = x^2 - 2x + 5$ and the ordinates $x = 1$ and $x = 2$.

3. a) Using MATLAB commands find $\frac{\partial^4 f}{\partial x^2 \partial y \partial z}$, where $f(x, y, z) = \sin(x^2 y) e^{-x^2 y - z^2}$.

   b) Write a user-defined function that converts temperature in degrees F to temperature in degrees C. Use the function to solve the following problem.

   The change in the length of an object ΔL, due to a change in the temperature ΔT, is given by: $\Delta L = \alpha L \Delta T$, where α is the coefficient of thermal expansion. Determine the change in the area of a rectangular ($4.5\ m$ by $2.25m$) aluminum ($\alpha = 23.10^{-6}\ 1/^oC$) plate if the temperature changes from 40^oF to 92^oF.

4. a)

   i) Solve and plot the solution to the following second order equation

   $$y''(x) + 8y'(x) + 2y(x) = \cos x\,; \qquad y(0) = 0,\ y'(0) = 1.$$

ii) Solve the following system of three ordinary differential equations

$$x'(t) = x(t) + 2y(t) - z(t)$$
$$y'(t) = x(t) + z(t)$$
$$z'(t) = 4x(t) - 4y(t) + 5z(t).$$

iii) Numerically approximate the solution of the first order differential equation

$$\frac{dy}{dx} - 4y = 9e^{-x}\cos x + 3\sin x + 10x\,; y(0) = 0$$

on the interval $x \in [0,20]$

b) A worker is paid according to his hourly wage up to 40 hours, and 50% more for overtime. Write a MATLAB program that calculates the pay to a worker.

The program asks the user to enter the number of hours and hourly wage and then display the pay.

5. A file named '**climate_stat.csv**' has the following data. Use this given data file to answer the following questions.

Year	Temperature (^0C)	Rainfall (mm)
2010	26.48	379.70
2011	26.71	399.84
2012	25.89	438.02
2013	27.11	309.78
2014	26.09	329.72
2015	27.04	385.03
2016	28.01	448.40
2017	27.23	429.97
2018	28.02	386.02
2019	26.99	400.56

(Note that the file is saved **only with the numeric data values**.)

a) Write a MATLAB command to import the given data file to MATLAB.

b) Write MATLAB code to compute the average rainfall.

c) Write a MATLAB command to estimate the temperature and the rainfall after the third quarter of year 2015.

d) Write a MATLAB command to obtain the temperature monthly from year 2016 to 2019 and plot the original temperature values and interpolated values in one figure.

e) Using MATLAB command, forecast the temperature from the year 2019 to 2021.

********* END OF QUESTION PAPER *********