



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

BACHELOR OF SCIENCE (MATHEMATICS)

COURSE CODE: MAT 3223-1

COURSE TITLE: MATLAB PROGRAMMING

DATE: APRIL, 2024

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Answer **Question One (Compulsory)** and **ANY other Two Questions**.
2. All Examination Rules Apply.

This paper consists of 5 printed pages. Please turn over

Question One (20 Marks)

- a. Define the following terms used in MATLAB programming
- i. Arrays **(1 Mark)**
 - ii. Loops **(1 Mark)**
 - iii. Create a vector with variable name, x in which the first term is m , the spacing is q and the last term is n and give an example in command window **(2 Marks)**
 - iv. Given the matrix below write a program in the command window showing spacing of two in the first two rows and use the line space command in the last two rows simultaneously

$$A = \begin{bmatrix} 1 & 3 & 5 & 7 & 9 & 11 \\ 0 & 5 & 10 & 15 & 20 & 25 \\ 10 & 20 & 30 & 40 & 50 & 60 \\ 67 & 2 & 43 & 68 & 4 & 13 \end{bmatrix}$$

(3 Marks)

- b. Name four windows that are contained in MATLAB desktop window. **(4 Marks)**
- c. Define a script file and write a program executing a script file of a Trigonometric identity given by $\cos^2 \frac{x}{2} = \frac{\tan x + \sin x}{2 \tan x}$ with $x = \frac{\pi}{5}$ **(4 Marks)**
- d. An object with an initial temperature of T_o that is placed at time $t = 0$ inside a chamber that has a constant temperature of T_s will experience a temperature change according to the equation $T = T_s + (T_o - T_s)e^{-kt}$ where T is the temperature of the object at time t and k is a constant. A soda can at a temperature 120°F after being left in the car is placed inside a refrigerator where the temperature is 38°F . Determine to the nearest degree the temperature of the can after three hours. Assume $k = 0.45$. First define all of the variables and then calculate the temperature using one MATLAB command. **(5 Marks)**

Question Two (15 Marks)

- a. Use matrix operation and write a program in the command window which solves the following system of linear equations using the rules of linear algebra

$$\begin{aligned}4x - 2y + 6z &= 8 \\2x + 8y + 2z &= 4 \\6x + 10y + 3z &= 0\end{aligned}$$

(5 Marks)

- b. The following table contains sales data of a Firestone tyre company from 2017 to 2023

| Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---------------------------|------|------|------|------|------|------|------|
| Sales (<i>Millions</i>) | 8 | 12 | 20 | 22 | 18 | 24 | 27 |

Write a MATLAB program in the command window where the vectors are created and a plot command is used with line specifiers: Dashed red line and asterisk marker, property name and property value: The line width is two points and marker size is twelve points. **(5 Marks)**

- c. Write a MATLAB program in the command window showing plot of the function $y = 3x^3 - 26x + 10$ and its first and second derivatives for the values of x in the range $-2 \leq x \leq 4$ all in the same plot. Specifications: line space 0.01, the line of the function should be continuous blue colour, first derivative with dashed red line and second derivative with dotted black line. **(5 Marks)**

Question Three (15 Marks)

- a. Figure 1 below is a simple two-dimensional plot that was created with MATLAB commands. Figure 1 contains two curves that show the variation of light intensity(lux) with distance(cm). One curve is constructed from data points measured in an experiment, and the other curve shows the variation of light as predicted by a theoretical model. The axes in figure1 are both linear, and different types of lines (one solid and one dashed) are used for the curves. The theoretical curve is shown with a solid line, while the

experimental points are connected with a dashed line. Each data point is marked with a circular marker.

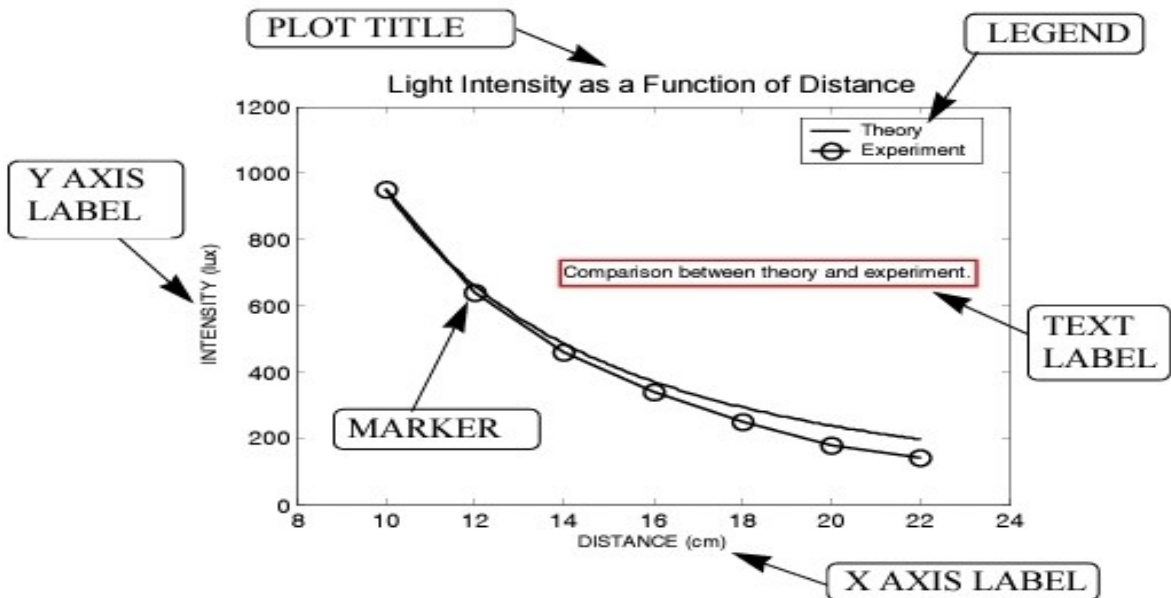


Figure 1: Formatted two-dimensional plot

The dashed line that connects the experimental points is actually red when the plot is displayed in the Figure Window. As shown, the plot in Figure 1 is formatted to have a title, axis titles, a legend, markers, and a boxed text label. Format the plot by using commands in a script file which was used to generate the formatted plot in Figure 1 **(10 Marks)**

b. Figure 2 shows the plot of a function $f(x)$

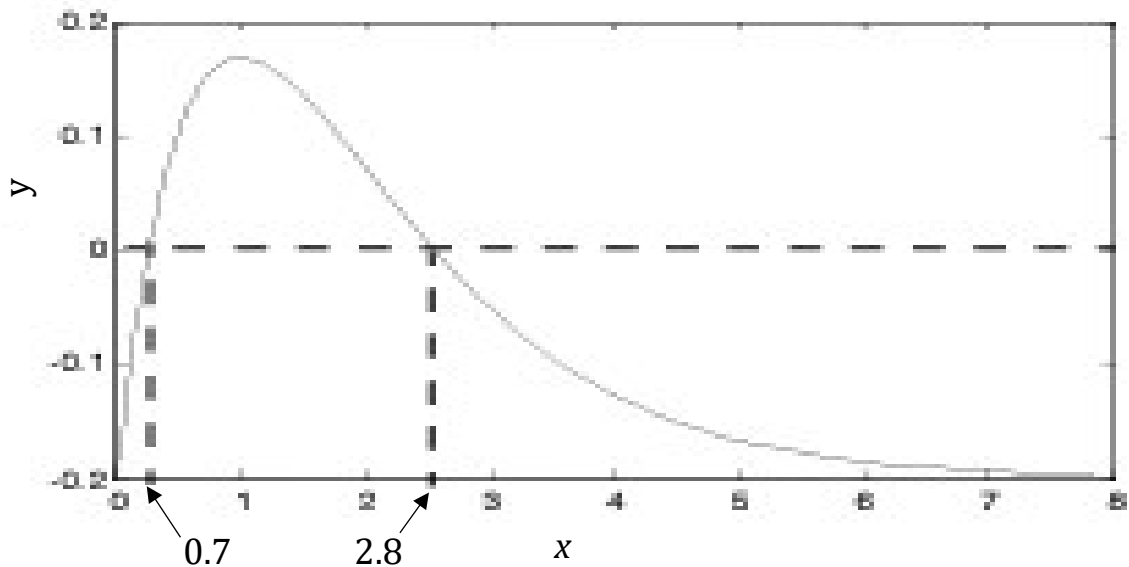


Figure 2: Plot of a function $f(x)$

Write a program in the command window determining the solution of a nonlinear equation $xe^{-x} = 0.2$ using the *fplot* and *fzero* commands guided by figure 2 above **(5 Marks)**

Question Four (15 Marks)

- a. Using a three-dimensional line plot, write a script file that can execute the plots of the coordinates x, y and z given a function of the parameter t by;

$$x = \sqrt{t \sin(2t)}$$

$$y = \sqrt{t \cos(2t)}$$

$$z = 0.5t$$

With the grid on, use the line space 0.1 with the points in the interval

$$0 \leq t \leq 6\pi \quad \textbf{(7 Marks)}$$

- b. The equation of a circle in the $x - y$ plane with radius, R and its center at point $(2,4)$ is given by $(x - 2)^2 + (y - 4)^2 = R^2$. The equation of the line in the plane is given by $y = \frac{x}{2} + 1$. Write a program in the command window which determines the coordinates of the points as a function of R where the line intersects the circle **(8 Marks)**

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