



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

MASER OF SCIENCE IN MATHEMATICAL MODELING AND COMPUTATION

SMA 803: FOUNDATIONS OF NUMERICAL COMPUTING

DATE:

TIME:

INSTRUCTIONS:

Answer Question ONE and ANY OTHER TWO

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Create the variables to represent the following matrices

$$A = [12 \ 17 \ 3 \ 4]$$

$$B = \begin{bmatrix} 5 & 8 & 3 \\ 1 & 2 & 3 \\ 2 & 4 & 6 \end{bmatrix}$$

$$C = [22 \ 17 \ 4]$$

- Assign to the variable $x1$ the third column of matrix B. (1 mark)
- Assign to the variable $x4$ the first three values of matrix A as the first row, and all the values in matrix B as the second, third and fourth rows. (2 marks)
- Which command will produce the following matrix from matrix B?

$$D = \begin{bmatrix} 8 & 3 \\ 2 & 4 \end{bmatrix} \quad (2 \text{ marks})$$

- b) Given the following system of linear equations, write MATLAB code that would be used to solve the same.

$$5x = 3y - 2z + 10$$

$$8y + 4z = 3x + 20$$

$$2x + 4y - 9z = 9 \quad (5 \text{ marks})$$

- c) An object with an initial temperature of T_0 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

$$T = T_s + (T_0 - T_s)e^{-kt}$$

- where T is the temperature of the object at time t , and k is a constant. A soda can at a temperature of 49°C (was left in the car) is placed inside a refrigerator where the temperature is 3°C . Determine, to the nearest degree, the temperature of the can after three hours. Assume $k = 0.45$. First define all the variables and then calculate the temperature using one MATLAB command. (4 marks)

- d) How many times will the following code print 'Hello World'?

```
n = 1;
while n > 0
    disp('Hello World ')
    n = n + 1;
end
```

(1 mark)

QUESTION TWO (20 MARKS)

- a) Describe any two ways in which a variable can be assigned a value. (2 marks)
- b) Write a function in MATLAB that will print out the relevant Grade for each mark entry that is input. An error message should be printed out in the event that the mark is less than 0, greater than 100 or non-numeric. (8 marks)
- c) Write a program that creates an $n \times m$ matrix with elements that have the following values. The value of each element in the first row is the number of the column. The value of each element in the first column is the number of the row. The rest of the elements each has a value equal to the sum of the element above it and the element to the left. When executed, the program should ask the user to enter values of n and m .

(10 marks)

QUESTION THREE (20 MARKS)

- a) Write a function in MATLAB to compute the value of the following function,

$$f(x) = \frac{x^4 \sqrt{3x + 5}}{(x^2 + 1)^2}$$

Write the function such that x can be a scalar or vector. Write code to compute the value of the function given $x = 7$. (5 marks)

- b) Given the polynomial $f(x) = x^5 - 12.1x^4 + 40.6x^3 - 17x^2 - 71.95x + 35.88$
- i) Write MATLAB code to calculate $f(7)$. (3 marks)
 - ii) Write MATLAB code to plot the polynomial for $-1.5 \leq x \leq 6.5$ (2 marks)

- c) A person in retirement is depositing \$300,000 in a saving account that pays 5% interest per year. The person plans to withdraw money from the account once a year. He starts by withdrawing \$25,000 after the first year, and in future years he increases the amount he withdraws according to the inflation rate. For example, if he inflation rate is 3%, he withdraws \$25,750 after the second year. Calculate the number of years the money in the account will last assuming a constant yearly inflation rate of 2%. (10 marks)

QUESTION FOUR (20 MARKS)

- a) Consider the function $f(x) = x^3 - 12x^2 + 40.25x - 36.5$, for $3 \leq x \leq 8$. Write code to find the location of the local minimum and the value of the function at this point. (5 marks)
- b) Write code to find the maximum of the function $f(x) = xe^{-x} - 0.2$ in the interval $0 \leq x \leq 8$. (5 marks)
- c) Write code to integrate the following function

$$\int_0^8 (xe^{-x^{0.8}} + 0.2) dx$$

(2 marks)

- d) The cost per Km for a rental car is Ksh 50 for the first 100 Kilometres, Ksh 30 for the next 200 Kilometres and Ksh 20 for all Kilometres in excess of 300 Kilometres. Write a function that determines the total cost for a given number of Kilometres. (8 marks)