MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

DIRECTORATE OF TVET

FIRST YEAR SECOND TERM EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (POWER OPTION)

(TELECOMMUNICATION OPTION)

MATHEMATICS 11

DATE: 22/4/2022 **TIME: 8.30-11.30 AM**

INSTRUCTIONS

You should have the following for this examination:

Mathematical tables/ Non programmable scientific calculator

Answer any five questions in the answer booklet provided.

All questions carry equal marks.

1. a) Given the matrices;

$$A=\begin{bmatrix}2 & 1 & 2\\ 1 & -2 & 3\end{bmatrix} \quad B=\begin{bmatrix}1 & -1\\ 2 & 1\\ 3 & 2\end{bmatrix} \quad \text{and } C=\begin{bmatrix}2 & 1 & 2\\ 3 & -1 & -3\\ -6 & -2 & -8\end{bmatrix} \text{ determine;}$$

i. BA

ii. $N = BA + C$

iii. N^{-1} (11 marks)

b) Three currents I_1 , I_2 and I_3 in an electric circuit satisfy the simultaneous equations;

$$I_1 + I_2 + I_3 = 12$$
$$2I_1 - 3I_2 + 2I_3 = 4$$
$$-4I_1 + 2I_2 + I_3 = 1$$

Use Cramer's rule to determine the values of the currents. (9 marks)

2. a) Give the vectors $\vec{A} = 2i - 3j + 4k$ *and* $\vec{B} = -3i + 2j - 6k$, determine;

i. The angle between $\vec{A}$ *and* $\vec{B}$

ii. A vector $\vec{C}$ that is perpendicular to both $\vec{A}$ *and* $\vec{B}$ (9 marks)

b) An electric potential $V_{(x,y,z)} = 2x^2y + zy^2$ exists in a region of space. Determine at the point $(1,1,-2)$

i. Grad V

ii. Div(Grad V)

iii. The directional derivative of V in the direction of the vector $\vec{A} = 2i + 3j + k$

(11 marks)

3. a) A continuous random variable X has a probability density function defined by;

$$f(x) = \begin{cases} c(1-x)^2 & ,1 < x < 4 \\ 0 & ,elsewhere \end{cases}$$ find the;

i. Value of the constant c

ii. Mean

iii. $p(1.5 \le x \le 2.5)$ (8 marks)

b) The lifespan of electric bulbs are normally distributed with a mean life of 2000 hrs. and a Standard deviation of 120 hrs. Determine the probability that the life span of a bulb will be;

i. Greater than 2150 hours

ii. Less than 1910 hours

iii. Between 1850 and 2090 hours (12 marks)

4. a) The relationship between the voltage V and the current I in an electric circuit is as shown in table 1

I	0	1	2	3	4	5
V	0.5	2.5	6.5	8.5	12.5	14.5

Determine the regression equation line of V and I (10 marks)

b) Table 1 below shows the marks scored by students in a mathematics examination

Marks	12-14	15-17	18-20	21-23	24-26	27-29
No of students	2	6	a	8	4	1

Given that the mean is 19.9, determine the;

i. value of a

ii. standard deviation (10 marks)

5. a) Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ given that $z = \frac{x-y}{x^3+y^2}$ (4 marks)

b) Use partial differentiation to determine the equation of the tangent to the curve $z = x^2 + 3xy + y^2 - 2x - 2y$ at the point $(1,1)$ (7 marks)

c) Locate the stationary points of the function $z = 2x^2 + 3y^2 - xy - 3x + 7y$ and determine their nature (9 marks)

6. a) A machine produces 11% defective resistors. Determine the probability that in a sample of 8 resistors chosen at random:

i. exactly 3 are defective

ii. atleast two are defective (5 marks)

b) Given the vectors $\vec{A} = i + 2j + 3k,\ \vec{B} = -i + 2j + k\ and\ \vec{C} = 4i + 4j$ determine x such

that $\vec{A} + X\vec{B}$ is perpendicular to $\vec{C}$ (5 marks)

c) Given the matrices $A = \begin{bmatrix} 2 & 4 & -6 \\ 4 & 0 & 2 \\ 6 & 2 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & -4 & 6 \\ 2 & -2 & 4 \\ 4 & 2 & 2 \end{bmatrix}$

i. Find $3A - 4B$

ii. Show that $(AB)^T = B^T A^T$ (10 marks)

7. a) Show that the general solution of the differential equation; $x^2 \frac{dx}{dy} = 2xy + y^2$ may be expressed in the form $x(x+y) = cy$ where c is an arbitrary constant (9 marks)

b) Using the method of undetermined coefficients, solve the differential equation;

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dx} + 3y = t^3 + t^2 + 2$$ (11 marks)