



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

DIRECTORATE OF TVET

THIRD YEAR FIRST TERM EXAMINATION FOR
DIPLOMA IN BUILDING AND CIVIL ENGINEERING
MATHEMATICS

DATE: 25/7/2022

TIME: 8:30 – 11:30 AM

INSTRUCTIONS

Answer **ALL** questions

Each question carries **20** marks

QUESTION ONE (20 MARKS)

- a) If x_n is an approximate root of the equation $x_n^3 - 3x_n^2 + 4x_n - 1 = 0$
- i. Show using Newton-Raphson method that a better approximation to the root is given by

$$x_{n+1} = \frac{x_n^3 - 3x_n^2 + 4x_n - 1}{2(x_n^2 - 3x_n + 1)} \quad (5 \text{ marks})$$

- ii. starting at $x_0 = -0.5$, find the root of the equation correct to five decimal point
(5 marks)

- b) A function $f(x)$ is defined by the data in the table below

X	1	2	3	4	5	6
F(x)	15	99	273	675	1403	2595

Use the Newton-Gregory difference formula to estimate $f(1.8)$ (10 marks)

QUESTION TWO (20 MARKS)

- a) Given the matrices

$$A = \begin{pmatrix} 2 & 4 & 1 \\ -1 & 2 & 3 \\ 0 & 1 & 2 \end{pmatrix} \quad B = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 1 & 5 \\ 6 & 0 & 2 \end{pmatrix}$$

Find $(A - B)B^T$

(5 marks)

- b) Given the matrix

$$C = \begin{pmatrix} 3 & x & 2x \\ 1 & 5 & 3 \\ -1 & 4x & 2 \end{pmatrix}$$

Is a singular matrix, determine the value of x .

(5 marks)

- c) Three forces acting on a mechanical system satisfies the simultaneous equations

$$f_1 + 2f_2 + 3f_3 = 14$$

$$2f_1 + 3f_2 + f_3 = 11$$

$$f_1 + f_2 + 2f_3 = 9$$

Use the inverse method to determine the magnitude of the three forces

(10 marks)

QUESTION THREE (20 MARKS)

- a) The table below satisfies a function
- $f(x)$

X	-1	0	1	2	3	4	5
F(x)	1	1	9	43	121	261	481

Evaluate

i. $f(2.5)$

ii. $f(4.8)$

(10 marks)

- b) Use the method of determinants to solve
- $$\begin{aligned} x + 2y + 3z &= -2 \\ 4x + 6y + 7z &= -7 \\ 5x + 8y + 9z &= -8 \end{aligned}$$

(10 marks)

QUESTION FOUR (20 MARKS)

- a) Given
- $x_n = 1.2345$
- $x_{n+1} = 1.2447$
- $x_{n+2} = 1.3124$
-
- $x_{n+3} = 1.3233$
- $f(x_n) = 12.5674$
- and
- $f(x_{n+2}) = 13.9831$

Use linear interpolation and extrapolation to Calculate $f(x_{n+1})$ and $f(x_{n+2})$ to 5 decimal places

(10 marks)

- b) Use the Newton-Raphson method to show that if x_0 is an approximation to the root of the equation $x^3 + 2x^2 - 5x = 1$ then a better approximation is given by $x_{n+1} = \frac{2x^3 + 2x^2 + 1}{3x^2 + 4x - 5}$ (5 marks)
- c) Given that $x_1 = 4$ as an approximation to $\sqrt{17}$ use iteration method to find a better approximation to the root (5 marks)

QUESTION FIVE (20 MARKS)

- a) Let X be a random variable with pdf given by $f(x) = \begin{cases} Cx^2 & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$
- Find
- The constant c
 - $E(x)$ and $\text{Var}(x)$
 - $P(x \geq 2)$ (10 marks)
- b) Let x be number of prior convicts for prisoners at a state prison at which there are 500 prisoners ($x=0, 1, 2, 3, 4$)

x	0	1	2	3	4
No of prisoners	80	265	100	40	15

Calculate

- Mean
- Variance
- Standard deviation of the prisoners