MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

DIRECTORATE OF TVET

THIRD YEAR FIRST TERM EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

ENGINEERING MATHEMATICS III

DATE: 25/7/2022 **TIME: 8:30 – 11:30 AM**

INSTRUCTIONS

Answer **ALL** questions

Each question carries **20** marks

QUESTION ONE (20 MARKS)

a) Determine the full-range Fourier series expansion $f(t)$ of period 2π defined by

$$f(t) = \begin{Bmatrix} \frac{2}{3}t & 0 \leq t \geq \frac{1}{3}\pi \\ \frac{1}{3}(\pi - t) & \frac{1}{3}\pi \leq t \geq \pi \\ f(t + 2\pi) & \end{Bmatrix}$$

To what value does the series converge at $t = \frac{\pi}{3}$ (10 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 formular to estimate f(1.8) (10 marks)

QUESTION TWO (20 MARKS)

a) If x_n is an approximation root of the equation $x^4 - 5x^2 + 7x - 8 = 0$

i. Show using Newton-Raphson method that a better approximation x_{n+1} is given by $x_{n+1} = \frac{3x_n^4 - 5x_n^2 + 8}{4x_n^3 - 10x_n + 7}$

ii. Starting with $x_0 = 1.5$ find the root of the equation correct to four decimal places. (10 marks)

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

x	1	2	3	4	5	6	7
F(x)	4	47	237	755	1853	3855	7157

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

QUESTION THREE (20 MARKS)

a) A function f(x) is defined by

$$f(x) = \begin{cases} 2 - x & 0 < x < 4 \\ x - 6 & 4 < x < 8 \\ f(x + 8) & \end{cases}$$

i. Sketch the function in the range $-4 < x < 8$

ii. Obtain the Fourier series for the function (14 marks)

b) Expand a function $f(x) = x_1 \quad 0 < x < 3$ in a half range Sine series (6 marks)

QUESTION FOUR (20 MARKS)

a) Given the matrix

$$M = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 6 & 7 \\ 5 & 8 & 9 \end{pmatrix}$$

i. Determine M^{-1}.

ii. Hence solve the equations

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

$4x + 6y + 7z = -7$

$5x + 8y + 9z = -8$ (10 marks)

b) Use the method of determinants to solve

$$\begin{aligned} 5x - 2y + z &= -7 \\ 3x - y + 2z &= -3 \\ 3y - x + z &= 0 \end{aligned}$$

(10 marks)

QUESTION FIVE (20 MARKS)

a) Given the matrix $M = \begin{pmatrix} 2 & -1 \\ 2 & 5 \end{pmatrix}$ Determine the eigen values and the corresponding eigen vectors (10 marks)

b) 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)