



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

HIGHER DIPLOMA IN TECHNOLOGY

ELECTRICAL POWER ENGINEERING

AMA 3251: **Engineering Mathematics IV**

END OF SEMESTER EXAMINATION

SERIES: OCTOBER 2016

TIME: 2HOURS

DATE: OCTOBER 2016

Instructions to Candidates

1. You should have the following for this examination

- *Answer Booklet*
- *examination pass*
- *student ID*
- *Electronic calculator*

2. This paper consists of FIVE Questions.

3. Attempt ANY THREE questions.

4. All questions carry equal marks.

5. This paper consists of FOUR printed pages.

Do not write on the question paper.

Question One (30 Marks)

a)

i) Determine $Z\left\{\frac{a^n}{n}\right\}, n \geq 1$ (3 marks)

ii) Use the change of scale theorem to prove that

$$Z\left\{a^k f(x_k)\right\} = F\left(\frac{z}{a}\right) \quad (5 \text{ marks})$$

b)

i) Given $f(x_k) = \begin{cases} 5^k, & k < 0 \\ 3^k, & k > 0 \end{cases}$

Determine the Z transform of $f(x_k)$ (5 marks)

ii) Determine the inverse Z-transform of

$$\frac{4z}{z-a} \text{ where } |z| > |a| \quad (5 \text{ marks})$$

c)

i) Solve $\frac{d^2 z}{dy^2} = z$, if $y = 0, z = e^x$ and $\frac{dz}{dy} = e^{-x}$ (5 marks)

ii) Use the convolution theorem to evaluate

$$Z^{-1}\left\{\frac{z^2}{(z-a)(z-b)}\right\} \quad (7 \text{ marks})$$

Question Two (20 Marks)

a)

i) Using direct division obtain the inverse Z transform of

$$\frac{1}{z-2} \text{ for } |z| > 2 \quad (4 \text{ marks})$$

ii) Determine the inverse Z-transform of

$$\log\left(\frac{z}{z+1}\right) \quad (6 \text{ marks})$$

b) Solve $\frac{\partial^3 z}{\partial x^3} - 4 \frac{\partial^3 z}{\partial x^2 \partial y} + 4 \frac{\partial^3 z}{\partial x \partial y^2} = 2 \sin(3x + 2y)$ (10 marks)

Question Three (20 Marks)

a)

i) Given $f(n) = \frac{a^n}{n!}$, determine $Z\{f(n)\}$ for $n \geq 0$ (4 marks)

ii) Using the Z-transform method solve the difference equation

$$Y_{k+1} - 2Y_{k-1} = 0, k \geq 1, y(0) = 1 \quad (6 \text{ marks})$$

b) Using the method of separation of variables, solve

$$\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u \text{ where } u(x,0) = 6e^{-3x} \quad (10 \text{ marks})$$

Question Four (20 Marks)

a) By making use of the standard integral $\int_{-\infty}^{\infty} \frac{\cos \omega x}{x^2 + a^2} dx = \frac{\pi}{a} e^{-|\omega|a} \quad a > 0$, determine the

Fourier transforms of

i) $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases} \quad (5 \text{ marks})$

ii) $g(x) = \frac{1}{x^2 + a^2} \quad (6 \text{ marks})$

b) Determine the Fourier transform of

$$f(x) = \exp(-a^2 x^2) (a > 0) \quad (9 \text{ marks})$$

Question Five (20 Marks)

a) Solve $\frac{\partial^2 z}{\partial x \partial y} = x^2 y$ subject to the condition $z(x,0) = x^2$ and $z(1,y) = \cos y$ (8 marks)

b) Use the Residual method to determine

$$Z^{-1} = \frac{3z^2 - 18z + 26}{(z-2)(z-3)(z-4)} \quad (12 \text{ marks})$$