



TECHICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING
DIPLOMA IN BUILDING & CIVIL ENGINEERING (DBCE 11)
DIPLOMA IN ARCHITECTURE (DA 11)

AMA 2315: ENGINEERING MATHEMATICS V

END OF SEMESTER EXAMINATION

SERIES: APRIL 2013

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Scientific Calculator*
- *Mathematical Table*

This paper consists of **FIVE** questions.
 Answer any **THREE** questions
 Maximum marks for each part of a question are as shown
 This paper consists of **THREE** printed pages
Question One

- a) Express $\frac{dw}{dt}$ as a function of t , if $w = e^{xy} + z$, $x = \cos 2t$, $y = \sin t$ and $z = e^{\sin t}$ **(6 marks)**
- b) Find the relative maximum and minimum values of the following function
 $f(x, y) = 3x^2y + xy + y^2 - 3x$ **(6 marks)**
- c) Determine the Fourier series to represent the periodic function shown below in figure 1. **(8 marks)**

Question Two

- a) Given that $f(x) = x + x^2$, $-\pi < x < \pi$. Determine the Fourier series expression of $f(x)$ **(8 marks)**
- b) Given $f(x, y) = 100x^{3/4}y^{1/4}$ where x represents the units of labour (at sh. 150 per unit) and y represent the units of capital (at sh. 250 per unit). The total cost of labour and capital is limited to sh. 50,000. Find the maximum production level for this manufacturer. **(8 marks)**
- c) The transformation of T is defined by $x = \frac{u}{v}$, $y = v$. Find the Jacobian transformation of T . **(4 marks)**

Question Three

- a) Solve the system $u = x - y$, $v = 2x + y$ for x and y in terms of u and v . Hence find the value of the Jacobian. **(6 marks)**
- b) Given the function $f(t + 2\pi) = 5(\pi - t)$, $0 < t < \pi$ find the half range sine series, if **(8 marks)**
- c) Minimize length of a metal, given as $f(x, y) = x^2 + 3y^2$, when subjected to heat constraint defined by $x + y = 2$. **(6 marks)**

Question Four

- a) Using Lagrange multipliers, determine the values of x, y, z that minimize the function $f(x, y, z) = 11xy + 14yz + 15xz$, subject to the constraint $xyz = 105,000$ (6 marks)

$$f(x, y) = x^2 + y^2 - xy + 3y$$

- b) Determine any relative extrema for (6 marks)

- c) Find the Fourier coefficients and Fourier series of the square-wave function f defined by:

$$f(x) = \begin{cases} 0 & \text{if } -\pi \leq x < 0 \\ 1 & \text{if } 0 \leq x < \pi \end{cases} \quad f(x, 2\pi) = f(x)$$

and (8 marks)

Question Five

- a) Find the partial derivative of w with respect to r , if:

$$w = x^2 + y^3, \quad x = r + e^{sr}, \quad y = \ln s$$

and (4 marks)

- b) Express $\frac{dw}{dt}$ as a function of t , if $w = e^{x^2} y^z, x = \ln t^2, y = \tan t$ and $z = e^{\tan 2t}$ (4 marks)

- c) Find the half range sine series of $f(x) = \frac{1}{2}x, 0 \leq x < \pi$ (8 marks)

- d) Determine relative maximum and minimum values of $f(x, y) = xy - x^3 - y^3$ (4 marks)