



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**DIPLOMA IN MEDICAL ENGINEERING**

**AMA2251: ENGINEERING MATHEMATICS IV**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 9 May 2016**

## Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

## Question ONE

- a) An inductor, resistor and capacitor are connected all in series to a supply voltage  $E_0$
- derive an equation involving current and time
  - solve for charge and current given that  $E_0 = 40V$ ,  $C = 250_F$ ,  $L = 50mH$ , and  $R = 30$ . take  $i = 0$  and  $q = 0$
  - iii) from the circuit calculate the voltage across the components involved.

(10 marks)

b) Use Laplace transform to solve  $2 \frac{d^2x}{dt^2} + 3 \frac{dx}{dt} - 5x = 6 \sin 2t$

(10 marks)

c) Solve the following differential equation

i.  $\frac{dy}{dx} = \frac{3}{x} - \frac{y}{x}$

ii.  $2y(1-x) = -(x+xy) \frac{dy}{dt}$

(10 marks)

## Question TWO

- a) Use Laplace transform to solve the following differential equation  $\frac{d^2x}{dt^2} + 6 \frac{dx}{dt} + 8x = 0$  given that  $x(0) = 4$  and  $x'(0) = 8$

(10 marks)

b) A body executes damped forced vibrations defined by the equation

$\frac{d^2y}{dx^2} + 2k \frac{dy}{dx} + b^2y = e^{-kt} \sin \omega t$ . Solve the differential equation for the following conditions

- i.  $\omega^2 = b^2 - k^2$
- ii.  $\omega^2 \neq b^2 - k^2$

(10 marks)

### Question THREE

Using the substitution  $x = e^t$

a. Express the differential equation  $x^2 \frac{d^2y}{dx^2} - 2y = x + 1$  in the form

$$a \frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = f(t)$$

b. Solve the equation in (a) above taking  $y = y$ ,  $x = 1$  and  $y' = 0.5$

(20 marks)

### Question FOUR

a) Solve  $\frac{d^2x}{dt^2} - 4 \frac{dx}{dt} + 3x = t^3$

(10 marks)

b) Solve the following simultaneous equation using Laplace transform given that  $t = 0$ ,  $x = 4$ ,  $y = 2$   $x' = y' = 0$

$$\frac{d^2x}{dt^2} + 2x = y$$

$$\frac{d^2y}{dt^2} + 2y = x$$

(10 marks)

### Question FIVE

a) Solve the following differential equations

- i.  $x - y + x \frac{dy}{dx} = 0$

- ii.  $\frac{dy}{dx} + x = 2y$

(10 mark)

b) Determine the inverse Laplace transform for the following

- i.  $\frac{5s^2 - 2s - 19}{(s+3)(s-1)^2}$

- ii.  $\frac{2s^2 - 9s - 35}{(s+1)(s-2)(s+3)}$

(10 marks)