(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR DIPLOMA
IN
ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: **DEE 071**
COURSE TITLE: **ENGINEERING MATHEMATICS IV**

DATE: Monday 25th April, 2022 **TIME: 8.00 AM-10.00AM**

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other TWO (2) questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE

a) Using first principles derivation, show that the Laplace transform of first derivative is given by $L\{f'(t)\} = sL\{f(t)\} - f(0)$ hence show that laplace transform of $e^{-at} = \frac{1}{s+a}$ *(7 Marks)*

b) Using a standard list of laplace transforms, determine the following :

i) $6 \sin 3t - 4 \cosh 5t$ *(2 Marks)*

ii) $1 + 2t - 3e^{-t} + \frac{1}{3}t^4$ *(2 Marks)*

(2 marks)

c) Let *f (x)* be function with a period of 2π over the interval 0 < x < 2π and has period 2π

$$f(x) = \frac{x}{2}$$

i) Sketch a graph of *f (x)* in the interval $-2\pi < x < 2\pi$ *(4 marks)*

ii) Find the full Fourier representation of the above function *(8 marks)*

d) Verify the final value theorem for the function $3t^2e^{-4t}$ and determine its steady state value. *(3 Marks)*

e) Find the Laplace inverse of the following $L^{-1}\{\frac{6}{s^3}\}$ *(2 marks)*

QUESTION TWO

a) Find the Laplace inverse of the below function by using its partial fractions

$$L^{-1}\left\{\frac{5s^2+8s-1}{(s+3)(s^2+1)}\right\}$$ *(9 marks)*

b) Verify the initial value theorem for the voltage function (5 + 2 cos 3t) volts, and state its initial value *(4 Marks)*

c) Find the Laplace transform of the following:

i) $L\{e^{-2t}\sin 3t\}$ *(3 marks)*

ii) $L\{2te^{3t}(4\cos 2t - 5\sin 2t)\}$ *(4 marks)*

QUESTION THREE

Let $f(x) = x$, be a function of a period 2π such that $f(x) = x$, in the range $-\pi < x < \pi$

i) Sketch a graph of the above function in the interval $-3\pi < x < 3\pi$ *(4 marks)*

ii) Find the Fourier half sine and cosine series for the above function *(12 marks)*

iii) Full Fourier series representation of the above function *(4 marks)*

QUESTION FOUR

a) Given that $f(x) = x^2$ has a period of 2π over the interval $-\pi < x < \pi$. Show that the Fourier series for f(x) in the interval $-\pi < x < \pi$ is

$$\frac{\pi^2}{3} - 4\left[\cos x - \frac{1}{2^2}\cos 2x + \frac{1}{3^2}\cos 3x - \dots\right]$$

(10 marks)

b) Solve the following differential equations using Laplace transforms

i) $\frac{dx}{dt} - 2x = 4$ at $t = 0, x = 1$ *(5 Marks)*

ii) $\frac{dx}{dt} + 2x = 10e^{3t}$ at $t = 0, x = 6$ *(5 Marks)*