



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES
DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:
DIPLOMA IN MECHANICAL ENGINEERING
AMA 2251: ENGINEERING MATHEMATICS IV
END OF SEMESTER EXAMINATION

SERIES: AUGUST 2017

TIME: 2 HOURS

DATE: Pick Date Aug 2017

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

Scientific calculator

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

Do not write on the question paper.

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Question One

- a) The velocity of a body, V is equal to the rate of change of distance $\frac{dx}{dt}$. Determine the equation for x in terms of t , given $V = u + at$ where u and a are constants and $x = 0$, when $t = 0$:

(4 marks)

- b) Solve the differential equation:

$$9 \frac{d^2 y}{dy^2} = 12 \frac{dy}{dt} + 4y = 0$$

Given

$$y = 3 \text{ when } t = 0 \text{ and } \frac{dy}{dt} = 4 \text{ when } t = 0$$

(8 marks)

- c) Obtain the inverse of the laplace transform function

$$\left\{ \frac{4S^2 - 5S + 6}{(S+1)(S^2+4)} \right\}$$

(7 marks)

- d) The periodic function $y = f(x)$, of period 2π is defined between $x = 0$ and $x = \pi$ by the function value given in table 1. If the function is known to contain odd harmonics only:

(i) Show that $a_0 = 0$

(ii) Determine a_1

(iii) Determine b_1

(11 marks)

Table 1

x^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0
y	0	8.0	11.5	6.0	4.0	5.4	0

Question Two

a) Solve the differential equation:

$$(y-x) \frac{dy}{dx} - \frac{y^2}{x} - y + X^2/y \quad \text{Given that } x=1 \text{ when } y=3 \quad \text{(8 marks)}$$

b) An equation of Motion may be represented by the equation

$$dv/dt + Kv^2 = 0 \text{ where}$$

V is the velocity of a body traveling in a restraining medium.

Show that:

$$V = \frac{V_0}{1 + KtV_0}$$

Given that:

$$V = V_0 \text{ when } t = 0 \quad \text{(5 marks)}$$

c) Solve the differential equation:

$$x \frac{dy}{dx} = y + x^2 - 2x \quad \text{given } X=1 \text{ when } y=3 \quad \text{(7 marks)}$$

Question Three

a) Solve the differential equation:

$$6 \frac{d^2y}{dx^2} + 5 \frac{dy}{dx} - 4y = 0, \quad \text{Given } y=11 \text{ when } x=0 \text{ and } \frac{dy}{dx} = 0 \text{ when } x=0 \quad \text{(8 marks)}$$

b) Solve the differential equation:

$$15 \frac{d^2y}{dx^2} - 2 \frac{dy}{dx} - y = 3X + 65\text{Sin}X \quad \text{(12 marks)}$$

Question Four

a) Obtain from first principles:

(i) $L\{t\}$ (4 marks)

(ii) $L\{e^{at}\}$ (3 marks)

b) Obtain using the appropriate shift theorem the laplace transform of

(i) $\{t \sin 2t\}$ (3 marks)

(ii) $\{e^{-3t} \sin 2t\}$ (3 marks)

c) Solve the equation $\frac{dx}{dt} + 2x = 10e^{3t}$ given that at $t = 0; X = 6$ (7 marks)

Question Five

The values of $f(x)$, a periodic function of period 2π , at intervals of 30° from $X = 0^\circ$ and $X = 360^\circ$ are as given in table 1.

Table 1

X°	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
$f(x)$	1.4	1.6	2.0	2.1	1.9	1.1	0.4	0.4	0.7	0.6	0.5	1.0	1.4

Determine the corresponding Fourier series for $f(x)$ up to the second harmonics. (20 marks)