TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS& PHYSICS

UNIVERSITY EXAMINATION FOR:

DIPLOMAIN MECHANICAL ENGINEERING

AMA 2251: ENGINEERING MATHEMATICS IV

END OF SEMESTER EXAMINATION

SERIES:AUGUST2017

TIME:2HOURS

DATE: Pick DateAug2017

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. Attemptquestion 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:

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

Given

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

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

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

$dv/dt + Kv^2 = 0$ where

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

Show that:

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

Given that:

$V = V_0$ when $t = 0$ **(5 marks)**

c) Solve the differential equation:

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

Question Three

a) Solve the differential equation:

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

b) Solve the differential equation:

$$15\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - y = 3X + 65SinX$$ **(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) $\left\{e^{-3t} Sin2t\right\}$ **(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 30^0 from $X = 0^0$ and $X = 360^0$ are as given in table 1.

Table 1

X^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0	210^0	240^0	270^0	300^0	330^0	360^0
$f(x)$	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)**