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

$y = 3$ 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:

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

Question Three

a) Solve the differential equation:

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