TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS & PHYSICS

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UNIVERSITY EXAMINATION FOR:

DIPLOMA IN MECHANICAL ENGINEERING

AMA 2251: ENGINEERING MATHEMATICS IV

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2HOURS

DATE: Pick Date Dec 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.

Q.1 a) A tank contains 50 litres of salt solution containing 1 Kg of salt. Another salt solution with 0.2Kg of salt per litre runs in at 3 litres/min and the mixture runs out at the same rate.

Determine the amount of salt in the tank

(i) After t – minutes
(ii) After 15 – minutes (10 marks)

b) Solve for y in the differential equation

$$xy = (1+x^2)\frac{dy}{dx}$$ (6 marks)

c) Obtain using the First shift theorem $L\{e^{-3t}Sin2t\}$ (3 marks)

d) Obtain $L^{-1}\left\{\frac{s^2-15s+4}{(s+2)(s-3)^2}\right\}$ (8 marks)

e) Given the following set of values

Xo	0	30	60	90	120	150	180	210	240	270	300	330
f(x)	1.8	1.7	1.5	1.0	0.6	0.4	0.5	1.0	1.6	2.0	2.1	1.9

Determine

(i) The constant term a_o in the Fourler series

(ii) The coefficient of f(x)Cosx, a_1.

Q.2 a) The rate at which a body cools is given by the equation $\frac{d\theta}{dt} = -k\theta$, where θ is the temperature of the body above its surrounding and k is a constant. Solve the Equation for θ given that at t = 0, $\theta = \theta_o$ (5 marks)

b) Solve the differential equation

$$(y-x)\frac{dy}{dx} = \frac{y^2}{x} - y + \frac{x^2}{y}$$

given that x=-1 when y=3. (9 marks)

c) Determine the particular solution of the differential equation

$\frac{dy}{dx} + 2x = y$, given that x = 0 and y = 2. (6 marks)

(3 marks)

Q.3 a) Obtain from first principles

(i) $L\{t^2\}$

(ii) $L\left\{\frac{d^2x}{dt^2}\right\}$ (10 marks)

b) Determine $L^{-1}\left\{\frac{5s+1}{S2-s-12}\right\}$

c) Use Laplace transforms to solve the Differential equation.

$\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 0$ given when t = 0, x = 4 and dx/dt = 3. (10 marks)

Q.5 Given the corresponding values for x^o and f(x) are as tabulated

X^0	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	-

Determine the Fourier series up to and including the second harmonic. (20 marks)

Q.2 a) Determine the particular solution to the differential equation

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

Given when x = 0, y = 2 and $\frac{dy}{dx} = 4$ (7 marks)

b) Determine the particular solution of the equation

$$3\frac{d^2x}{dt^2} + \frac{dy}{dx} - 4y = e^{-3x}$$

Given the boundary conditions that when x = 0, y = 3/5 and $\frac{dy}{dx} = -64/5$ (13 Marks)