TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCE

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR

THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS, RENEWABLE ENERGY AND ENVIROMENTAL PHYSICS & BACHELOR SCIENCE IN STATISTICS AND COMPUTER SCIENCE , MECHANICAL, CIVIL, ELECTRICAL AND ELECTRONICS ENGINEERING

SMA2278/ SMA 2271 / AMA 4204: ORDINARY DIFFERENTIAL EQUATIONS

END OF SEMESTER EXAMINATION- **SERIES: MAY 2016**

TIME: 2 HOURS

<u>Instructions to Candidates</u>

You should have the following to do this examination:

-*Answer Booklet, examination pass and student ID*

Do not write on the question paper.

Answer question One and any other two

Question ONE (30 marks)

a) Using the differential operator evaluate $(D^2+5)\{\sin x\}$. (3 marks)

b) Using a solution form the complimentary function of $y'' - y = e^x$ hence solve by reduction of order to obtain the particular integral. (6 marks)

c) Use Bernoulli's method to solve $2x\dfrac{dy}{dx} - y = 4y^3$. (5 marks)

d) Find the inverse laplace transform of $F(S)=\frac{s+2}{s^2-4s+3}$ (4 marks)

e) Determine the general solution if $(x+y)dx+(3x+3y-4)dy=0$ (6 marks)

f) The initial temperature of a body is 53^0c and after 5 minutes its temperature is 45^0c, from Newton's law of cooling it is known that the rate of cooling of a body is proportional to the temperature difference between the body and its surrounding room temperature. Use this to predict the temperature of the body after a further 5 minutes given that the room temperature was constant at 21^0C. (6 marks)

Question TWO (20 marks)

a) Solve the linear fractional differential equation $\frac{dy}{dx}=\frac{x+y-3}{x-y-1}$. (7 marks)

b) Obtain the complimentary function hence find the particular integral of $(D^2+1)y=\tan x$ by variation of parameter method. (9 marks)

c) Solve the differential equation $\frac{d^2y}{dx^2}+4\frac{dy}{dx}+5y=0$. (4 marks)

Question THREE (20 marks)

a) Identify all regular singular points in the differential equation

$$\left(x^3-3x^2+2x\right)\frac{d^2y}{dx^2}+\left(x-2\right)\frac{dy}{dx}+4x^2y=0.$$ (5 marks)

b) Solve the differential equation $\frac{d^2y}{dx^2}+5\frac{dy}{dx}=3$. (4 marks)

c) Use D-operator method to find the general solution to $\left(D^2+3D-4\right)y=\sin 2x$. (5 marks)

d) An object moves with simple harmonic motion on the x axis. Initially it is located at a distance 46 m away from the origin when t=0 and has velocity v=15 m/s and decelerating at $100m/s^2$ directed towards the origin O. find the equation of the position at any time t. (6 marks)

Question FOUR (20 marks)

a) Solve the differential equation $\frac{dy}{dx} = \frac{y^2 - 1}{x}$ (4 marks)

b) Solve the differential equation $\frac{d^2y}{dx^2} + 14\frac{dy}{dx} + 49y = 0.$ (3 marks)

c) Solve the linear differential equation $(x^2 + 9)\frac{dy}{dx} + xy = 0$ if y(0)=1. (5 marks)

d) If $y_1 = e^{2x}$ is a solution of $y'' - 4y = 0$ find a 2nd independent solution of this differential equation. (8 marks)

Question Five (20 marks)

a) Verify whether it's an exact differential equation hence solve $(y^3 + 2x)dx + (3xy + 1)dy = 0$. (5 marks)

b) Use Laplace transform to solve $\frac{dx}{dt} - 2x = 4$ given at t=0 then x=1. (6 marks)

c) An electric circuit consists of an inductance of 0.1 henry a resistance of 20 ohms and a condenser of capacitance 25 microfarads. Find the charge q and the current i at any time t, given that the initial conditions are q =0.05 coulombs and $i = \frac{dq}{dt} = 0$ when t =0 if

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = E(t).$$ (9 marks)

THE END