THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

INSTITUTIONAL BASED PROGRAMME

UNIVERSITY EXAMINATIONS FOR DEGREE IN
BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING
YR II, SEM II

SMA 2271: ORDINARY DIFFERENTIAL EQUATIONS

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: FEBRUARY/MARCH 2012
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*

This paper consists of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other two questions
This paper consist of **TWO** printed pages

SECTION A (COMPULSORY)

Question One (30 Marks)

a) Explain what is a homogeneous function, hence determine the homogenouity of the function

$$f(x,y) = e^{\frac{y}{x}} + \tan {}^{y}\!/_{x}$$

. (3mark)

b) Find the Laplace transform of $e^{-3t}(2\cos 5t - 3\sin 3t)$ (5 marks)

c) Using the method of undetermined coefficient determine a general solution of an equation. (7 marks)

d) Use the method of frobenius to find the solution of the differential equation

$$2x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}+(x-5)y=0$$

(12 marks)

e) Find the general solution of $\frac{dy}{dx}+y=e^x$. (3 marks)

SECTION B (ANSWER ANY TWO QUESTIONS FROM THIS SECTION)

Question Two (20 Marks)

a) Find the inverse Laplace transform of $F(s)=\frac{3s+7}{s^2-4}$. (4 marks)

b) Solve the equation $(3x^2+4xy)dx+(2x^2+2y)dy=0$ (8 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 $L\frac{d^2q}{dt^2}+R\frac{dq}{dt}+\frac{q}{C}=E(t)$. (8 marks)

Question Three (20 Marks)

a) Solve $\frac{dy}{dx}+y\cot x=\cos x$ to obtain the particular solution given that at $x=\frac{\pi}{2},$ the $y=\frac{5}{2}$. (6 marks)

b) Obtain a general solution of the equation $(x^2-xy+y^2)dx-xydy=0$. (8 marks)

c) 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) a) By separation of variables solve $y\tan x\frac{dy}{dx}=(4+y^2)\sec^2 x$. (4 marks)

b) Find the particular solution for the initial value problem $(x^2+y^2)dx+2xydy=0$ if $y(1)=1$. (8 marks)

c) Given the equation $L\frac{di}{dt} + Ri = E(t)$, find an expression for i if $E(t) = E_0$ when the initial current is i_0 provided that L=3 henries, R=15ohms in a 60 cycle sine wave of amplitude 110volts, while $i = 0$ when t=0. (8 marks)

<u>Question Five (20 marks)</u>

a) Find the Laplace inverse of $\frac{s+2}{s^2 - 4s + 3}$. (5 marks)

b) Solve the 2nd order differential equation

$$y\frac{d^2y}{dx^2} = 2\left[\frac{dy}{dx}\right]^2 - 2\left[\frac{dy}{dx}\right]$$

(7 marks)

c) A particle of mass 2kg moves along the x-axis attracted towards the origin O by a force whose magnitude is numerically equal to 8x. if it is initially at rest at x=20 and has also a damping force whose magnitude is numerically equal to 8 times the instantaneous speed. Find the equations of displacement and velocity of the particle at any time t. (8 marks)