UGANDA MARTYRS UNIVERSITY
FACULTY OF SCIENCE

DIFFERENRIAL EQUATIONS I

BSC 1 Gen, IT & FM FINAL ASSESSMENT

DATE: 8TH MAY 2008. TIME 9:00-12:00 NOON

Instructions

Attempt any **five** (05) questions
Read each question carefully before attempting
Questions carry equal marks

Question 1.

Solve the following differential equations:

i) $(3x^2y - 1)\,dx + (x^3 + 6y - y^2)\,dy = 0;\; y(0) = 3$

ii) $(3e^xy + x)\,dx + e^x\,dy = 0;\; y(0) = 1.$

Question 2.

An object moves along the x – axis in such a way that its position at a time t > 0 is given by the linear differential equation,

$$\frac{dx}{dt} + (t - t^{-1})x = t^2.$$

If the object were at position x = 2 when t = 1, where will it be when t = 3?

Question 3.

a) Solve the following Bernoulli's equation,
$$\frac{dy}{dx} - 5y = \frac{-5}{2}xy^3 \text{ given that when } x = 0,\ y = 0.$$

b) Find a particular solution to the Cauchy- Euler equation given below,

$$x^2y'' - 3xy' + 3y = 0,$$

with initial values: $y(1) = 2$ and $y'(0) = 1$.

Question 4.

a) Show that $y_1 = x^2$ and $y_2 = x^{-1}$ are linearly independent solutions to the differential equation,
$$x^2y'' - 2y = 0.$$

Find the unique solution subject to $y(1) = -2$ and $y'(1) = 7$.

b) Use the method of the Wronskian to obtain a general solution to the differential equation,

$$(x^2 + 1)y'' - 2xy' + 2y = 0$$ given that $y_1 = -x$ is one of the linearly independent solutions.

Question 5.

Solve the following initial value problems:

a) $y'' - 6y' + 13y = 0$; $y(0) = 1$ and $y'(0) = 2$

b) $y'' + 3y' + 2y = 6xe^x$; $y(0) = 1$ and $y'(0) = 0$.

Question 6

a) Find the general solution,

$$\frac{d3y}{dx^3} + 8y = \sin x$$

b) Use the method of undetermined coefficients to obtain a solution to the differential equation,

$$y''' - 3y'' + 2y' = 1 - x^2.$$

Question 7.

a) Given the differential equation,

$$a_2(x)y'' + a_1(x)y' + a_o(x)y = 0.$$

Define what is meant by the point $x = x_o$ being;

(i) an ordinary point

(ii) a singular point

(iii) a regular point

of the given differential equation.

b) Identify the ordinary, regular singular and / or irregular singular points of the differential equation,

$$x(x + 3)y'' + x^2y' - y = 0.$$

c) Find the power series solution of the differential equation,

$y' + xy = 0$ about $x_o = 0$.

END.