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**KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**UNIVERSITY EXAMINATION, 2016/2017 ACADEMIC YEAR**  
**SECOND YEAR, FIRST SEMESTER EXAMINATION**  
**FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(MATHEMATICS)**

Date: 11<sup>th</sup> August, 2016.  
Time: 11.00am – 1.00pm

**KMA 303 - INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS**

**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE (30 MARKS)**

- a) Define the following terms;
- i) Order of a differential equation (2 Marks)
  - ii) Exact differential equation (2 Marks)
- b) Verify that  $3e^{-2x} + 4e^x$  is solution of the equation;

$$\frac{d^3 y}{dx^3} - 3 \frac{dy}{dx} + 2y = 0$$

(5 Marks)

- c) Solve the differential equation  $\frac{dy}{dx} = x^2 + 3 + e^{2x}$  given that  $y(0) = -1$  (5 Marks)
- d) Obtain the general solution of  $dr = b(\cos \theta dr + r \sin \theta d\theta)$  (5 Marks)
- e) Determine whether the equation  $2xydy + (x^2 + y^2)dy = 0$  is exact or not. If exact, solve it. (5 Marks)
- f) Radium decays at a rate proportional to the amount present at any time. If the half life of radium is 6 years, determine the amount present after  $t$  years if the initial amount is  $M_0$ . (6 Marks)

**QUESTION TWO (20 MARKS)**

- a) Determine the integrating factor of the equation;

$$(x^5 + 3y)dx - xdy = 0 \text{ and hence solve it.}$$

(4 Marks)

- b) Solve the equation  $(3x^2 - 2y^2)\frac{dy}{dx} = 2xy$ :  $y(0) = -1$

(7 Marks)

- c) Solve the Bernoulli equation  $2x^2 \frac{dy}{dx} = xy + y^3$

(4 Marks)

- d) Solve the non-homogeneous linear differential equation

$$\frac{d^2y}{dx^2} - 10\frac{dy}{dx} + 41y = \sin x$$

(5 Marks)

**QUESTION THREE (20 MARKS)**

Solve each of the equations;

- a)  $(3x^2 + y \cos x)dx - (\sin x - 4y)dy = 0$

(4 Marks)

- b)  $(x^3 - 2xy^2)dy = (4x^2y - y^3)dx$

(7 Marks)

- c)  $(y + yx)\frac{dy}{dx} + xy + x = 0$ ;  $y(0) = 0$

(5 Marks)

- d)  $(3x^4y - 1)dx + x^5dy = 0$ ;  $y(1) = 1$

(4 Marks)

**QUESTION FOUR (20 MARKS)**

- a) At 1.00pm the temperature of a metallic bar is  $200^\circ F$ . At 1.30 pm its temperature is  $160^\circ F$ . Assuming the surrounding temperature is maintained at  $80^\circ F$ , at what time will the temperature will be  $100^\circ F$ .

(10 Marks)

- b) Find the general solution of the differential equation;

$$(D^5 - D^4 - D^3 - D^2 + 4D - 2)y = 0$$

(4 Marks)

- c) Solve the initial value problem  $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$  given that;

$$y(0) = 4, y'(0) = 11, y''(0) = 17$$

(6 Marks)

**QUESTION FIVE (20 MARKS)**

a) Obtain the general solution of  $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x$  using the method of undetermined coefficients.

(6 Marks)

b) Use method of variation of the parameters to solve  $(D^2 + 4D + 4)y = x^{-2}e^{2x}$

(5 Marks)

c) Use the power series method to solve the initial value problem

$$y'' + 9y = 0; \quad y(0) = 1, \quad y'(0) = 0$$

(9 Marks)