

Mount Kenya



University

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UNIVERSITY EXAMINATION 2015/2016

SCHOOL OF PURE AND APPLIED SCIENCES  
DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

BED (SCIENCE), BED (ARTS) AND BSNE  
SCHOOL BASED

UNIT CODE: BMA2108

UNIT TITLE: ORDINARY DIFFERENTIAL  
EQUATION 1

DATE: DECEMBER 2015

MAIN EXAM

TIME: 2 HOURS

Instructions: Answer question one and any other two

Question one (30 marks)

a) Define and give an example of an ordinary differential equation. (3 Marks)

b) Solve  $\frac{dy}{dx} = \frac{2x^2}{y^3}$  (3 Marks)

c) Show that  $(3x^2 + 4xy)dx + (2x^2 + 2y)dy = 0$  is exact (3 Marks)

ii) Hence solve the equation (4 Marks)

d) Show that  $y = e^{4t}$  is a solution to the differential equation  $y' - 4y = 0$  (3 Marks)

e) Solve  $x \frac{dy}{dx} + y = x^2$  (5 Marks)

f) Solve  $\frac{d^3y}{dx^3} + 10 \frac{dy}{dx} + 25y = 0$  (3 Marks)

**Question two (20 marks)**

a) Define homogenous equation of first order. (3 Marks)

b) Show that  $\frac{xy}{x^2 + y^2}$  is a homogenous function in x and y (3 Marks)

ii) Using the method of separation of variables solve the equation in 2(b) I above (6 Marks)

c) Suppose that a differential equation has a regular singular point  $x_0 = 0$  and has indicial roots and  $r=2$  suppose further that the recurrence relation for the coefficients for the first solution  $y_1$  is as follows  $a_n = \frac{-(n+1)}{n(n+3)} a_{n-1}$ . Let  $a_0 = 1$  and find  $y_1$  (8 Marks)

**Question three (20 marks)**

a) Define Bernoulli equation (2 Marks)

b) Solve  $\frac{dy}{dx} - y = 4y^5$   $\Rightarrow \frac{dy}{dx} - y = 4y^5$  (8 Marks)

c) Solve the equation  $\frac{d^4 y}{dx^4} + 2 \frac{d^3 y}{dx^3} + \frac{d^2 y}{dx^2} = \sin 3x$  (10 Marks)

**Question four (20 marks)**

a) The point  $x_0=0$  is an ordinary point of the differential equation  $(1-x^2)y'' - 2y' + 3y = 0$ . Begin the process of finding a series solution for this

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differential equation. Find the recurrence relation for the coefficient  $a_n$ .

(10 Marks)

b) Solve the initial value problem  $\frac{dy}{dx} = \frac{y^2 + 4x^2}{4xy}$ ,  $y(1) = 2$

(10 Marks)

**Question five (20 marks)**

a) Show  $y_1 = x^2$  is a solution to the differential equation  $x^2 y'' - (x^2 + 4x) y' + (2x + 6) y = 0$ .

Also find a second independent solution in  $y_2$

(10 Marks)

b) Solve the following equation  $xy' + 4y = x^3 y^2$

(10 Marks)

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