



(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR
SECOND YEAR SECOND SEMESTER
MAIN EXAMINATION
FOR THE DEGREE OF BACHELOR OF EDUCATION
SCIENCE

COURSE CODE: MAA 224

COURSE TITLE: ORDINARY DIFFERENTIAL EQUATIONS I

DATE: 13/4/2023

TIME: 9:00 AM - 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE COMPULSORY (30 MARKS)

- (a) Define the following terms
- Differential equation
 - Initial Value Problem
 - Order of differential equation (3 marks)
- (b) Determine the order and linearity of the following ordinary differential equation
- $$\left(\frac{d^5 y}{dx^5}\right)^2 + 4\left(\frac{dy}{dx}\right)^6 = x^{10} y \quad (2 \text{ marks})$$
- (c) Using an appropriate method, solve $\frac{dy}{dx} = \frac{y}{x} + \frac{y^2}{x^2}$ (4 marks)
- (d) Use operator method to solve $\frac{d^3 y}{dx^3} - 2\frac{d^2 y}{dx^2} - 5\frac{dy}{dx} + 6y = e^{3x}$ (6 marks)
- (e) Show that $\frac{dy}{dx} = \frac{x^2}{y+x^3y}$ is separable and find its particular solution under the condition $y(0) = -2$ (4 marks)
- (f) Verify that the functions x and xe^x are linearly independent solutions of
- $$x^2 \frac{d^2 y}{dx^2} - x(x+2) \frac{dy}{dx} + (x+2)y = 0 \quad (6 \text{ marks})$$
- (g) Test for exactness and solve the following ordinary differential equation
- $$(\cos x - x \sin x + y^2)dx + 2xy dy = 0 \quad (5 \text{ marks})$$

QUESTION TWO (20 MARKS)

- (a) Solve $\frac{dy}{dx} = \frac{xy^2+x}{x^2y+y}$ (4 marks)
- (b) Solve $(3y - 7x + 7)dx - (7y - 3x + 3)dy = 0$ (7 marks)
- (c) A loaf of bread is removed from an oven at a temperature of 300°C and placed in a room whose temperature is 70°C . 3 minutes later, the temperature of the bread is 200°C .
- Find its temperature function at any time t . (7 marks)
 - How long will it take to cool to 150°C . (2 marks)

QUESTION THREE (20 MARKS)

(a) Write the standard form of a linear first order ordinary differential equation giving an example. (2 marks)

(b) Use operator method to solve $2 \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + 3y = x$ (7 marks)

(c) Solve the non-linear equation $x^2 \frac{dy}{dx} - 2xy = 3y^4$ (6 marks)

(d) Solve the Cauchy-Euler's equation

$$x^3 \frac{d^2y}{dx^2} + 5x^2 \frac{dy}{dx} + 7x \frac{dy}{dx} + 8y = 0 \quad (5 \text{ marks})$$

QUESTION FOUR (20 MARKS)

(a) Use the method of variation of parameters to solve

$$\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + y = \frac{e^x}{x^2+1} \quad (8 \text{ marks})$$

(b) Test for exactness then solve the following differential equations

i. $(y^2 - x)dx + 2ydy = 0$ (7 marks)

ii. $(\cos(x + y^2) + 3y) dx + (2y \cos(x + y^2) + 3x)dy = 0$ (5 marks)

QUESTION FIVE (20 MARKS)

(a) Use the method of undetermined coefficients to solve

$$\frac{d^3y}{dx^3} - \frac{d^2y}{dx^2} + \frac{dy}{dx} - y = x^2 + x \quad (8 \text{ marks})$$

(b) Solve the following differential equations using appropriate method

i. $\frac{dy}{dx} = \frac{xy+y^2}{x^2-xy}$ (5 marks)

ii. $(x + 2y - 1)dx + (3x + 6y)dy = 0$ (7 marks)

END