MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL
SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2024/2025 ACADEMIC YEAR

SECOND YEAR **FIRST** SEMESTER EXAMINATION FOR BACHELOR

OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

AMM 214 – MATHEMATICS III

DURATION: 2 HOURS

<u>**INSTRUCTIONS TO CANDIDATES:**</u>

1. Answer question ONE and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

(a) Define order and degree of a differential equation hence determines the order, degree and linearity of the equation $\left(\frac{d^2y}{dx^2}\right)^4 - \left(\frac{dy}{dx}\right)^5 + 3y = e^x$ (3 marks)

(b) Obtain a differential equation associated with the primitive $y = Ae^{2x} + Be^x + C$ (3 marks)

(c) Solve the equation $(2x^2y + y)dx + xdy = 0$ (4 marks)

(d) Show that the following differential equation is homogenous, and hence find its solution $x\frac{dy}{dx} = y + \frac{y^2}{x}$ (4 marks)

(e) Find the general solution of the equation $(3x^2 + 4xy)dx + (2x^2 + 2y)dy = 0$.   (4 marks)

(f) Solve the following differential equation $xdy + (2xy - x)\,dx = 0$ (4 marks)

(g) Solve the following equation $\frac{dy}{dx} - \frac{y}{x} = y^3$ (4 marks)

(h) Find the particular integral of $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = e^{-3x}$ (4 marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

(a) Use the method of variation of parameters to find the complete solution of the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x \ln x$, x>0   (10 marks)

(b) Use Euler's method to approximate the solution of the differential equation $\frac{dy}{dx} = x + y,$ with the initial condition y(0) = 1, over the interval [0,1], using a step size of h=0.2. (6 marks)

(c) Find the general solution of $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 5y = 0$ (4 marks)

QUESTION THREE (20 MARKS)

(a) Solve the following system $\frac{dx}{dt} = x + y, \frac{dy}{dt} = -2x + 4y$ subject to the initial condition x(0) = -1 and y(0) = 3.   (10 marks)

(b) Solve the following Euler-Cauchy type differential equations $x^2\frac{d^2y}{dx^2} - 5x\frac{dy}{dx} + 8y = 2\ln x$ (10 marks)

QUESTION FOUR (20 MARKS)

(a) Find power series solution of the following differential equation about the ordinary point at x_0 = 0. $\frac{dy}{dx} = 5y$ (10 marks)

(b) Use the method of undetermined coefficient to find the complete solution of the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = xe^{-x}$ (10 marks)