MUEO

MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR
(ACADEMICS, RESEARCH & EXTENSION)

UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINEERING

COURSE CODE: MAT 208

COURSE TITLE: ENGIENERING MATHEMATICS II

DATE: 29TH APRIL, 2019 **TIME:** 2.00 P.M. – 5.00 P.M.

INSTRUCTION TO CANDIDATES

- SEE INSIDE.

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MOI UNIVERSITY
UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

BACHELOR OF ENGINEERING

2:30

MAIN EXAMINATION

COURSE CODE: MAT 208

COURSE TITLE: ENGINEERING MATHEMATICS II

Date: Time:

INSTRUCTIONS TO CANDIDATES

- Attempt **ALL** questions in Section **A** and attempt any **THREE** questions in Section **B**

SECTION A (31 MARKS)

QUESTION ONE (16 MARKS)

(a) Form the differential equation whose root is given by

$Y = y = A\cos 5x + B\sin 5x$ (3 Mks)

(b) Solve the differential equation $(2xy + x^2)\frac{dy}{dx} = 3y^2 + 2xy$ by making use of the substituition $y = vx$ (5 Mks)

(c) Show that $(5x^4 + 3x^2y^2 - 2xy^3)\,dx + (2x^3y - 3x^2y^2 - 5y^4)\,dy = 0$ is an exact differential.

Hence solve the equation (5 Mks)

(d) Solve the homogeneous equation $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$ (3 Mks)

QUESTION TWO (15 MARKS)

(a) Show that $y = ae^{3x} + be^{x}$ is a solution of the differential equation

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 0$ (6 Mks)

(b) Using the method of separation of variables, solve the equation $x\frac{dy}{dx} = \frac{1}{y^2+1}$ (6 Mks)

(c) Define the term "order of an ordinary differential equation" (3 Mks)

SECTION B (39 MARKS)

QUESTION THREE (13 MARKS)

(a) List the three classifications as used to describe differential equations (3 Mks)

(b) Show that $x^2 + y^2 = 30$ is an implicit solution of the non- linear differential equation $y\,dy + x\,dx = 0$ (5 Mks)

(c) The rate at which a body cools is proportional to the difference between the temperature of the body and that of the surrounding air. If a body in air at 25^0c will cool from 100^0c to 75^0c in one minute, find its temperature at the end of three minutes if this relationship is governed by the equation $\frac{dy}{dx} = k(T - T_{a)}$ where k is a constant, T is temperature and T_a is the air temperature (5 Mks)

QUESTION FOUR (13 MARKS)

(a) Using the method of undetermined coefficients, solve the second order differential equation $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 9y = 0$ (6 Mks)

(b) Form a partial differential equation from the equation $x^2 + y^2 + (z - b)^2 = d$ Where b and d are arbitrary constants (7 Mks)

QUESTION FIVE (13 MARKS)

(a) Solve the partial differential equation $\frac{\partial^2 z}{\partial x\, \partial y} = x^2y$ subject to the conditions $z(x,0) = x^2, z(1,y) = \cos y$ (7 Mks)

(b) Solve the differential equation

$\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 9y = 0$ (6 Mks)

QUESTION SIX (13 MARKS)

(a) A rod of length l units with insulated sides is initially at a uniform temperature $U(x, y)$. Its ends are suddenly cooled to 10^0c and are kept at that temperature.
Prove that the temperature function U (x, y) is given by

$$U(x,y) = \sum_{n=1}^{\infty} b_n \sin\frac{n\pi x}{l} e^{\frac{-c^2\pi^2 n^2 t}{l^2}}$$

Subject to the conditions U (0, t) = 0, U (l, t) = 0 (9 Mks)

(b) Show that $z = 3x^2 + 2xy - 3y^2$ satisfies the Laplace equation
$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$ (4 Mks)

QUESTION SEVEN (13 MARKS

(a) Find the solution to the initial value problem

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 0$$

using series solution method

(9 Mks)

(b) Solve the differential equation using integrating factor method

$$\frac{dy}{dx} + \frac{1}{x}y = x^3 - 3$$

(4 mks)