MUEO

MOI UNIVERSITY

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

UNIVERSITY EXAMINATIONS

2016/2017 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINEERING

COURSE CODE: MAT 208

COURSE TITLE: ENGINEERING MATHEMATICS IV

DATE: 6TH JUNE, 2017 **TIME:** 9.00 A.M. – 12.00 NOON.

INSTRUCTION TO CANDIDATES

- SEE INSIDE.

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MOI UNIVERSITY

CODE: MAT 208 TITLE: ENGINEERING MATHS IV

EXAMINATION FOR ENGINEERING BACHELORS PROGRAMMES

INSTRUCTION

ANSWER ALL QUESTIONS IN SECTION A AND ANY OTHER THREE IN SECTION B

SECTION A (31 MARKS): ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE(15MARKS)

(a) Use the method of undetermined coefficients to obtain the general solution of the ordinary equation $y'' - y' - 2y = 4x^2 + \cos x$ (5Mks)

(b) Solve the first order linear partial differential equation $x^2u_x - xyu_y + 2yu = 0$ satisfying the equations $u = y^2e^y$ when $x = 1$ (5Mks)

(c) Find out whether the following differential equation is homogeneous or not. If it is then use the substitution $y = ux$ to solve it. $(x^2 + y^2)dx + xydy = 0$ (5Mks)

QUESTION TWO(16MARKS)

(a) Prove $\frac{d}{dx}x^{-k}J_k(x) = -x^{-k}J_{k+1}(x)$ (5Mks)

(b) State Rodriquez formula and express $f(x) = x^4 + 2x^3 + 2x^2 - x = 3$ in terms of Legendre polynomials. (5Mks)

(c) Define the beta function $\beta(m, n)$ and show that $\beta(m, n) = 2\int_0^{\frac{\pi}{2}} \sin^{2my}\theta \cos^{2n-1}\theta d\theta$ and hence evaluate $\beta(\frac{5}{2}, \frac{3}{2})$ (6Mks)

SECTION B-ANSWER ANY THREE QUESTIONS

QUESTION THREE(13MARKS)

Find a power series solution in powers of $(x - 1)$ of the initial value problem

$xy'' + y' + 2y = 0$

$$y(1) = 1, y'(1) = 4$$

QUESTION FOUR (13MARKS)

Derive the solution of the wave equation

$$a^2 y_{xx} - g = y_{tt}$$

Subject to the boundary conditions

$$\left.\begin{array}{l} y(0,t=0 \\ y(\pi,t)=0 \end{array}\right\} 0 \le t \le \infty$$

and initial conditions

$$y(x,0) = x$$

$$y_t(x,0) = x$$

QUESTION FIVE(13MARKS)

(a) Solve the equation by the method of variation of parameters

$$\frac{d^2y}{dx^2} - \frac{3dy}{dx} + 2y = \frac{1}{1+e^{-x}}$$ (8Mks)

(b) Solve the Bernoulli equation

$$\frac{dy}{dx} - y = xy^5$$ (5Mks)

QUESTION SIX(13MARKS)

Find the solution of the initial boundary value problem for the heat equation

$$K^2 u_{xx} = u_t$$

satisfying the following initial boundary conditions

$$\left.\begin{array}{l} u_x(0,t) = 0 \\ u_x(\pi,t) = 0 \end{array}\right\} 0 \le t < \infty$$

$$u(x,0) = x \quad 0 \le x \le \pi$$

QUESTION SEVEN(13MARKS)

(a) (i) Define gamma function (1Mk)

(ii) Evaluate$\Gamma(2)$ by using the definition of gamma. (2Mks)

(iii) Prove that $\Gamma(n+1) = n\Gamma(n)$ and hence find $\Gamma(6)$ (4Mks)

(b) (i) Classify partial differential equation

$$\frac{\partial^2 u}{\partial x^2}+\frac{3\partial^2 u}{\partial x\theta y}+\frac{4\partial^2 u}{\partial y^2}+\frac{5\partial u}{\partial x}+\frac{2\partial u}{\partial y}+4u=2x-3y$$ (2Mks)

(ii) Locate and identify the singular points of the differential equation

$$(x^2+x-2)^2y''+3(x+2)y'+(x-2)y=0$$ (4Mks)