MURANG'A UNIVERSITY COLLEGE

A constituent college of Jomo Kenyatta University of Agriculture and Technology

University Examination 2015/2016

END OF SEMESTER 2 EXAMINATION FOR THE DIPLOMA OF SCIENCE IN ENGINEERING–YEAR 2

SEE 1207: ENGINEERING MATHEMATICS IV

DATE: 7th DECEMBER 2015 **TIME: 2 HOURS**

Instructions: Attempt question **One** and any other **Two** questions

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Question One (30 Marks)

a) Solve $\frac{dy}{dx} = \frac{xy^2 + x}{yx^2 + y}$ (4 mks)

(b) Solve the differential equation $\frac{dy}{dx} = 4\frac{y}{x}$ (3 mks)

(c) Determine whether the equation $(xy^2 + 4x^2y)\,dx + (3x^2y + 4x^3)dy = 0$ is exact (4 mks)

(d) Find the characteristic polynomial of the following differential equation and hence solve it (3 mks)

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

(e) Find the differential equation whose solution is (4 mks)

$$y = A\cos 8x + B\sin 8x$$

(f) Solve

$$(D^2 - 4)y = e^{3x}x^2$$ (5 mks)

g) Find solution to the differential equation (3 mks)

$$\frac{dy}{dx} - \frac{y}{1+x^2}$$

(h) Consider the following initial value problem

$y^{11} - 4y^{1} - 12y = f(t)$ $y(0) = 3$, $y^{1}(0) = 0$

$F(t) = \begin{cases} 0 & 0 \leq t < 11 \\ 4 & t \geq 1 \end{cases}$

Begin the process of solving the initial problem using the Laplace transform method.
Find the function y(s) = y(t) (4 mks)

Question two (20 marks)

(a) Find the order and degree of the following differential equations.

(i) $\frac{d^2y}{2} + 7\left(\frac{dy}{dx}\right) + 8y^2 = \sin x$ (2 mks)

(ii) $\left(\frac{d^2y}{dx^2}\right)^{3/2} + 10\left(\frac{dy}{dx}\right)^8 + 9y = \cos x$ (2 mks)

(b) solve the equation (8 mks)

$X^2 3y(x^2 - 3y^2)dx + 2xydx = 0$

(c) Solve $\frac{dy}{dx} + y = xy^3$ (6 mks)

Question three (20 marks)

(a) Find the particular integral for the equation

$(D^2 - 5D + 6)y = e^{2t}$

Hence solve the equation (10 mks)

(b) Define linear and non linear equations (4 mks)

(c) Solve $4\frac{d^3y}{dx^3} - 12\frac{dy}{dx} + 5y = 0$ (6mks)

(d) Compute the following integral (5 mks)

$\int \frac{x-7}{x^2+2x-5}dx$

Question four (20 marks)

The following initial problem models a spring –mass system

$X^{11} + 4x^{1} + 3x = f(t) + e^{-2t}$, $x(0) = 0$ $x^{1}(0) = 0$

(a) Assuming that the mass of the object u m = 2, identify the following parameters of the system.

(i) Spring constant k (2 mks)

(ii) the damping coefficient c (2 mks)

(iii) the external force f(t) (2 mks)

(b) solve the initial value problem using the Laplace transform method show all the steps needed to justify your answer and write these steps in clear and organized fashion. (6 mks)

(c) Consider a damped simple harmonic oscillator whose displacement (t) satisfies the ODE

$mU^{11} + Yu^{1} + ku = 0$ where m, Y,k are positive constants let

$E(t) = ½m(u^{1})^{2} + ½ku^{2}$

show that if $Y > 0$ then E^{1} (t)   0 unless $u^{1}(t) = 0$ give a physical interpretation of this result. (8 mks)

Question five (20 MKS)

(a) Reduce $\frac{d^4y}{dx^4} - 5\frac{d^3y}{dx^3} + 7\frac{d^2y}{dx^2} + 9\frac{dy}{dx} - 6 = e^x$ to a system of for linear equations

(10 mks)

(b) Solve the equation

$(3x + 2y - 5)\,dx + (2x + 3y - 5)dy = 0$ (10 mks)