KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (ENGINEERING)

EMM 207: MATHEMATICS FOR ENGINEERING III

DATE: Thursday 15th December 2011 TIME: 2.00p.m – 4.00p.m

INSTRUCTIONS

Answer question ONE and any other TWO

Question One (COMPULSORY) 30 Marks

a) Form the differential equation from the following primitive equation and hence state the order and degree of each differential equation

   i) $y = Ax + A^2$ [3marks]

   ii) $y^2 = ae^{3x} + be^x$ [4marks]

b) Solve the 1st order differential equations $(x+1)\frac{dy}{dx} = x(y^2+1)$ [5marks]

c) If $dy/dx + 2y\tan x = \sin x$ *and* $y = 0$ *for* $x = \pi/3$, show that $y = 1/8$ is the maximum value. [5marks]

d) The rate of 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^oC will cools from 100^o C to 75^o in one minute, determine its temperature at the end of three minutes. [6marks]

e) Solve the initial value problem $2y'' + 5y' = 2y = e^{-2t}$ for y(o) = 1 and y'(o) = 1.

   Using Laplace Transform. [6marks]

Question Two (20 marks)

a) Solve the homogeneous differential equation $\frac{dy}{dx} = y/x + x\sin y/x$.

[4marks]

b) Test for exactness in the d.e $\left(y^2\, e^{xy^2} +\ 4x^3\right)dx + \left(2xye^{xy^2} -\ 3y^2\right)dy = 0$ [5marks]

c) Solve the Bernoulli equations $sec^2\ \ y\ dy/dx + x\tan y =\ x^3$ [6marks]

d) Uranium disintegrates at a rate proportional to the amount present at any instant. If M_1, and M_2 grams of uranium are present at time t_1 and t_2 respectively show that the half-life of uranium is $\frac{(t_1-t_2)\log 2}{Log\,\frac{m_1}{m_2}}$ [5marks]

Question three (20marks)

a) Solve the following differential equation

i) $y'' +\ y' +\ y = \cos 2x.$ [5marks]

ii) $D^4 + 2D^2 + 1)\, y =\ x^2 \cos x.$ [5marks]

iii) $y' +\ y/x = x^3 - 3$ [5marks]

b) Solve the equation$L\frac{di}{dt} +\ R_i =\ E_0 \sin wt$ where L, R and E_o are constants. [5marks]

Question four (20marks)

a) Test for exactness in the differential equation and hence solve it $(2x\, log^x -\ xy)dy + 2dyx = 0$ [5marks]

b) i) Define Laplace transform of *f(t).* [2marks]

iii) Find the Laplace transform of

$$f(t) = \begin{cases} t/k & when\ 0 < t < k \\ 1 & when\ t > k \end{cases}$$ [3marks]

c) Find the inverse Laplace transform of $F(s) = \frac{1}{s(s^2-16)}$ [4marks]

d) Using Laplace transform technique solve the initial value problem$y'' +\ 2y' + 2\, y = 5\sin x$ for *y (o) = y′= 0.* [6marks]

Question five (20marks)

a) Differentiate between the following terms as used in differential equations

i) Particular solution and general solution. [3marks]

ii) Order and degree [2marks]

b) Classify the following differential equation into its order and degree.

$y''' =\ \sqrt{y' +\ y}$ [4marks]

c) A mechanical system with two degree of freedom satisfies the equation

$$2\frac{d^2x}{dt^2} + 3\frac{dy}{dx} = 4 \text{ and}$$

$$2\frac{d^2x}{dt^2} - 3\frac{dx}{dt} = 0$$

Obtain an expression for x and y in terms of t given x, $y\frac{dx}{dt}$, dy/dt vanish at t = 0. [5marks]

d) Determine the particular solution of the differential equation $y^4y' - x - 1 = 0$ for *y (2) = 1*. [6marks]