# MURANG'A UNIVERSITY COLLEGE

*(A Constituent college of Jomo Kenyatta University of Agriculture and Technology*

## SEM 1302 ENGINEERING MATHEMATICS V1

**DATE: 9TH DECEMBER, 2015** **TIME:**

---

**INSTRUCTIONS:**

Answer question **ONE** and **ANY** other **TWO** questions.

**QUESTION ONE(30MKS):COMPULSORY**

a) Define the following terms:

i. Ordinary differential equation. (1mk)

ii. Partial differential equation. (1mk)

b) State the order and the degree of the following differential equations:

i. $\left(\frac{d^2y}{dx^2}\right)^3 + \frac{dy}{dx} = \sin x$ (2mks)

ii. $\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{2}} = k\frac{d^2y}{dx^2}$ (2mks)

c) Show that the function $f(x,y) = x^2 - y^2 + 2y$ is harmonic function. (3mks)

d) Find the complete general solution of the following equation:

$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6 = 0$ (3mks)

e) Evaluate $L^{-1}\left[\frac{2s+1}{s^3-4s}\right]$ (5mks)

f) Show that the equation $(3x^2 + 4xy)dx + (2x^2 + 2y)dy = 0$ is an exact differential equation. (2mks)

Hence solve the equation. (3mks)

g) Solve the following homogeneous differential equations of the first order.

$(x^2 - y^2)\frac{dy}{dx} = 2xy$ (4mks)

h) Evaluate

$L[t^2e^{3t}]$ (4mks)

**QUESTION TWO(20mks)**

a) Solve the following homogeneous equation of first order

$(x^2 - 3y^2)dx + 2xydy = 0$ (5mks)

b) Solve the following differential equation by the method of separation of the variables

$\frac{dy}{dx} = \frac{xy^2+x}{yx^2+y}$ (5mks)

c) Calculate the complete solution of the following differential equation:

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$ (5mks)

d) Evaluate $L^{-1}\left[\frac{3s+1}{s^2+4s+13}\right]$ (5mks)

**QUESTION THREE(20mks)**

a) Let $f(z) = 2z^2 + 3z + 5i + 6$ be analytic. Show that the real and imaginary parts of $f(z)$ are harmonic. (5mks)

b) Show that the equation $(2xy + 1)dx + (x^2 + 4y)dy = 0$ is exact.

Hence, solve the equation. (5mks)

c) Solve the first order linear differential below using the method of integrating factor.

$x\frac{dy}{dx} = y + x^3 + 3x^2 - 2x$ (5mks)

d) Solve the following homogeneous differential equations of the first order.

$xy\frac{dy}{dx} = 3x^2 + xy$ (5mks)

**QUESTION FOUR(20mks)**

a) Solve the first order linear differential below using the method of integrating factor.

$\frac{dy}{dx} = y\tan x - \sec x$ (5mks)

b) Solve the following Bernoulli's equation.

$\frac{dy}{dx} - y = 4y^5$ (5mks)

c) Use the method of undetermined coefficients to solve

$y'' - 2y' - 3y = 3t^2 + 4t - 5$ (6mks)

d) Evaluate $L[e^{2t} \sin 3t]$ (4mks)

**QUESTION FIVE (20mks)**

a) Solve the following Bernoulli equation:

$\frac{dy}{dx} + y = xy^3$ (7mks)

b) Prove that the transformation of $f(x, y) = x^2 - y^2 + 2y$ is also harmonic under the transformation $z = w^3$. (3mks)

c) Evaluate:

$y\frac{dy}{dx} = 2x + y$ (5mks)

d) Evaluate:

$L^{-1}\left[\frac{2s+4}{s^2-6s+25}\right]$ (5mks)