Murang'a University College

(A Constituent College of Jomo Kenyatta University of Agriculture and Technology)

University Examination 2014/2015

Supplementary Examination for the Diploma in Mechanical Engineering

SEM 1201: ENGINEERING MATHEMATICS III

Date: August 2015 2 Hours

Instructions: Attempt Question One and any other Two Questions.

Question One (30 Marks)

a) Find the derivative $\frac{dy}{dx}$ given the function $y = \frac{3Cos(x)}{5x^3-2}$ (4 Marks)

b) Find the coordinates of the point on the curve $y = 3\sqrt[3]{x^2}$ where the gradient is 1.0 (3 Marks)

c) Given the implicit function $2xy^3 - x^2y^2 - 3y + x^3 = 0$ find $\frac{dy}{dx}$ (4 Marks)

d) Find the equation of the tangent to the curve $y = 2x^3 - 3x + 4$ at a point (1,3) (5 Marks)

e) Find the solution to the indefinite integral $\int(2x + 4)e^{5x}dx$ (5 Marks)

f) Given the complex numbers $z_1 = 2 - 3j$, $z_2 = 4 - j$ and $z_3 = 2z_1 - \frac{1}{z_2}$ express z_3 in cartesian form (5 Marks)

g) Given that $3 - j$ is a root of the equation $z^2 + az + b = 0$, where a and b are constants, determine the values of a and b (4 Marks)

Question Two (20 Marks)

a) The base radius r of a right circular cone is increasing at the rate of 2.50 cm/sec while the perpendicular height h is decreasing at the rate of 2.0 cm/sec. Determine the rate at which the volume is changing at an instant when $r = 4.0cm$ and $h = 7.0cm$ (5 Marks)

b) Find and classify the stationary points of the surface $z = (x^2 + y^2)^2 + 2(x^2 - y^2)$ (15 Marks)

Question Three (20 Marks)

a) Use first principles to find the derivative of the function $f(x) = \frac{x}{1+x}$ (6 Marks)

b) Differentiate the function $y = e^{cos(x)}$ (4 Marks)

c) Find and classify the stationary points of the function $y = (x^2 - 3)e^x$ (10 Marks)

Question Four (20 Marks)

a) Evaluate $\int_0^1 (\frac{2x}{x^2+1})dx$ (7 marks)

b) Find the mean value of the function $y = \frac{x^2+1}{x-1}$ between $x = 2$ and $x = 5$ (8 Marks)

c) A police cruiser, approaching a right-angled intersection from the north, is chasing a speeding car that has turned the corner and is now moving straight east. When the cruiser is 0.6 km north of the intersection and the car is 0.8km to the east, the police determine with radar that the distance between them and the car is increasing at 20 km/h. If the cruiser is moving at 60 km/h at the instant of measurement, what is the speed of the car? (5 Marks)

Question Five (20 Marks)

a) Given that $z = 2 + j$ is a root of the equation $2z^4 - 9z^3 + 13z^2 + kz - 5 = 0$, find the value of k hence determine the other roots of the equation (9 Marks)

b) Find all the cube-roots of the complex number $z = 1 - j$ leaving yours answers in Cartesian form (11 Marks)