TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology in Conjunction with Kenya Institute of Highways and Building & Technology (KIHBT)

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

HIGHER DIPLOMA IN BUILDING ECONOMICS

MATHEMATICS III

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: AUGUST 2013
TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Scientific Calculator*
- *Mathematical Table*

This paper consists of **FIVE** questions. Answer any **THREE** questions

Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (20 marks)

a) Solve the equation:

$$(1+x)\frac{dy}{dx}+(1+2x)y=(1+x)^2$$

(5 marks)

b) Show that the second moment of area for a rectangular plane surface parallel to the length can be expressed in the form:

$$AK^2_{GG}=\frac{Ab^2}{12}$$

where A = Area
KGG = radius of gyration
b = Breadth

c) Find the second moment of area for the surface shown in figure 1 about yy' axis. **(7 marks)**

y

Question Two (20 marks)

a) The distance covered by a body; d (in meters) is related to the time taken, t (in minutes) by an expression of the form;

$$d=15-3t-t2+\frac{t^3}{3}$$

Find:

(i) The distance covered when the body comes to rest
(ii) The acceleration during the 10^{th} minute **(5 marks)**

b) A rectangular piece of plot is to be fenced using a fence of perimeter 800m. Find the dimensions of the plot if the plot is to have a maximum area. **(5 marks)**

c) (i) A cylindrical tank of maximum volume $10m^3$ is to be fabricated using a special sheet. Find the dimensions of the tank if surface area of the material to be used has to be minimum.

(ii) Show that the surface area is actually a minimum **(10 marks)**

Question Three (20 marks)

$$\left(1+x^2\right)\frac{dy}{dx}=\frac{y}{y+5}$$

a) Find the general solution for the equation . **(5 marks)**

$$y=8x^3-24yx+16$$

b) (i) Sketch the function given y(1) = 0

(ii) Determine the area for the sketch in b(i)

(iii) Find volume for solid for revolution if area is b(i) is rotated about x- axis through 1 revolution. **(15 marks)**

Question Four (20 marks)

A rectangular sheet of metal measures 20cm by 15cm. Square pieces of the material are removed from each corner. Find the maximum volume for an open box formed if the sides are folded accordingly. **(8 marks)**

$$\left(y-x\right)\frac{dy}{dx}=\frac{y^2}{x}+y$$

a) Solve the equation when y =3 for x = 1 **(7 marks)**

b) 0:1 filling a container shaped in form of an inverted cone rises at a rate of $20cm^3/s$. The V-angle of the cone is 55^o, find the rate at which radius of the surface for the oil is changing. **(5 marks)**

Question Five (20 marks)

$$y^2+2xy\frac{dy}{dx}=e^x$$

a) Find the general solution for: **(5 marks)**

$$\frac{dy}{dx}+y\cot x=\cos x$$

b) Solve the equation **(6 marks)**

c) Solve the equation;

$$\frac{d^2y}{dx}+u\frac{dy}{dx}+3y=6 \qquad \frac{dy}{dx}=4$$

given that y (0) = 0 and **(9 marks)**