THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

((A Constituent College of JKUAT)

(A Centre of Excellence)

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

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

HIGHER DIPLOMA IN BUILDING & CIVIL ENGINEERING

EBE 3201: MATHEMATICS

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2012
TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Mathematical Table/Calculator*

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) Deflection of a team is represented by the following differential equation.

Y'' + 100y = 10

Determine an expression for y, when;

i) $y(0) = 0,\ y'(0) = 1$

ii) $y(0) = 0,\ y'(0) = 2$ **(12 marks)**

b) A particle oscillates with simple harmonic motion its displacement is expressed as

$x = (5cm)\cos(2 + \pi/6)$, where x is in cm and t in seconds.

At $t = 0$, find:-

i) Displacement of particle
ii) Its velocity, and
iii) Its acceleration
iv) Period and amplitude of motion. **(5 marks)**

c) Find the area under the parabola $y = x^2$ for x between 0 and 3. **(3 marks)**

Question Two (20 marks)

a) Determine the area of the region enclosed by $y = \sin x$ and $y = \cos x$ at $x = \pi/4$ and the y-axis. **(6 marks)**

b) A 4 kg object is attached to a spring and will stretch the spring 350mm by itself. There is no damping in the system and a forcing function of the form $F(t) = 10\cos(wt)$, is attached to the object and the system experience resonance. If the object is initially displaced 20cm downward from its equilibrium position and given a velocity of 10m/sec upward. Find the displacement at any time t. **(5 marks)**

c) Suppose you throw a hammer to a friend, who is 25 feet above you. Determine:

(i) If you throw the hammer at an initial velocity of $V_o = 32\,ft/\sec$. Determine its distance.

(ii) Determine smallest possible value of V_o to enable hammer reach your friend. **(6 marks)**

d) Evaluate, $\frac{1}{2}d^2y/dx^2 + 2\,dy/dx + y = 0$ **(3 marks)**

Question Three (20 marks)

a) Solve the following initial value problem, $d^2y/dx^2 + 4y = 2$ given that, x = 0, y = 0. $dy/dx = 7$ **(8 marks)**

b) You are having a free falling object whose acceleration due to gravity is -24ft/sec^2
Determine:-
i) Initial velocity
ii) Initial distance of the object **(7 marks)**

$$2y''+6y'+y=0$$

c) Find the general solution of the differential equations **(5 marks)**

Question Four (20 marks)

$$y=x^2 \qquad y=x$$

a) Find the area between the curves, and **(5 marks)**

b) An object 30m below ground level accelerates at a rate of 4tm/sec^2. Determine its height after 6 seconds. **(5 marks)**

$$y=x^3 \qquad y=\sqrt{x}$$

c) Find the centre of the mass for the region by and **(10 marks)**

Question Five (20 marks)

$$2y''+7y'+3y=7$$

a) Determine the general solution for **(7 marks)**

$$y=\sqrt{9-x^2} \quad -2\le x\le 2,$$

b) Determine the surface area of the solid obtained by rotating about the x-axis. **(5 marks)**

c) Given that a 4kg weight stretched a spring 8 inches from its natural length. The weight is pulled down an additional 6 inches and released with an initial upward velocity of 8ft/second. Determine a formula for the opposition of the weight as a function of time, t. **(8 marks)**