TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN MECHANICAL ENGINEERING (DME)

AMA 2104: ENGINEERING MATHEMATICS I

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
-    *Answer Booklet*
This paper consist of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Solve for x in the following equations:

$$\frac{3^y}{9^{x^2}} = 3^{x-1}$$

(i) when y = 0

$$9^x + 3^{2x-2} = 10$$

(ii) **(12 marks)**

b) Given that
$$y = 3x^2$$

$$\log_3 y = 1 + 2\log_3 x$$

(i) Show that

(ii) Hence solve the equation
$$1 + 2\log_3 x = \log_3(28x - 9)$$

(10 marks)

c) Expand $(1-x)^{\frac{1}{3}}$ in ascending powers of x as far as the fourth term. By taking the first two terms of the expansion and substituting $x = \frac{1}{1000}$ find the value of $(37)^{\frac{1}{3}}$ correct to six significant figures.

(8 marks)

Question Two

a) A certain mechanical system has the amount of swing given by:
$$S = Ke^{-01t}$$
where K is a constant and t is time in seconds. Determine the time it takes for the amount of swing to reduce to a third initial amount. **(7 marks)**

b) A ball is thrown straight up from 3m above the ground, with a velocity of 14m/s. Given $S = K + ut - \frac{1}{2}gt^2$, where S is the height above the ground. When does it hit the ground?

(8 marks)

c) Solve by completing the square, the quadratic equation:
$$ax^2 + bx + c = 0$$

(5 marks)

Question Three

a) Solve for θ values between $0°$ and $360°$ in the equations.

$$2\sin\theta + 7\cos\theta = 4$$

(i)

$$\cos(\theta + 20^\circ) - \cos(\theta - 70^\circ) = 0$$

(ii)

$$2\tan^2\theta + \sec\theta = 1$$

(iii)

(16 marks)

b) Prove the identity:

$$\sin 2x = \frac{2\tan x}{1+\tan^2 x}$$

(4 marks)

Question Four

a) In a geometric progression, the eighth term is 8 times the fifth and the sum of the 6th and 7th term is 288. Determine:
 (i) Common ratio
 (ii) The first term
 (iii) Sum from the 5th to 10th term **(8 marks)**

b) If ksh 500 is invested at a compound interest of 6.5% per annum? Determine:
 (i) The value after 10 years
 (ii) The time, correct to the nearest year.
 It takes for the total amount to reach kshs 1200. **(6 marks)**

c) The eighth term of an arithmetical progression is twice the third term and the sum of the first eight terms is 39.
 (i) Find the first three terms of the progression.

$$\tfrac{3}{8}n(n+5)$$

 (ii) Show that the sum to n-terms is **(6 marks)**

Question Five

$$\left(1+\tfrac{1}{2}x\right)^{10}$$

a) Obtain the first four terms of the expansion of   in ascending powers of x. Hence find the

$$(1.005)^{10}$$

value of   correct to four decimal places. **(6 marks)**

b) Show that if x is small enough for its cube and higher powers to be neglected:

$$\sqrt{\frac{1-x}{1+x}} = 1 - x + \frac{x^2}{2} \qquad x = \tfrac{1}{8} \qquad \sqrt{7} = 2\frac{83}{128}$$

                    and by putting   show that **(9 marks)**

c) Pressure P and volume v are related by the expression:

$$PV^3 = C$$

where c is a constant. Find the approximate percentage change in C when P is increased by 2% and v increased by 0.8% **(5 marks)**