TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Mechanical Engineering
AMA 2150 : Engineering Mathematics I
END OF SEMESTER EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date **Aug 2019**

Instruction to Candidates:

You should have the following for this examination

- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE (Compulsory)** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

a) Solve for x in the following equations: **(10 marks)**

$$21 = 33\left(1 - e^{-x/2}\right)$$

$$9^{x+1} + 3^{2x-1} = 28$$

b) The displacement of a body from a certain fixed position is given by;

$$A = Ce^{-0.1t}$$

Where A is the displacement, C is a constant and t is time in seconds.

Determine an expression for the time it takes for the displacement to reduce to half the initial amount. **(6 marks)**

c) If $x = -2$ is one of the solutions to the equation $5x^3 + 2x^2 - 26x - 20 = 0$, determine the other roots of x. **(5 marks)**

d) Prove the identity: **(5 marks)**

$$\tan 3A = \frac{3\tan A - \tan^3 A}{1 - 3\tan^2 A}$$

e) 250 grams of a radioactive substance disintegrate at a rate of 2.5% per annum. How much of the substance is remaining after 15 years? **(4 marks)**

Question TWO

a) Derive the quadratic formula: **(10 marks)**

$$x = \frac{-b \pm \sqrt{b^2} - 4ac}{2a}$$

Hence solve for x in equation;

$$2^{2x} - 2^x - 6 = 0$$

b) When the expression $x^5 + 4x^2 + ax + b$ is divided by $x^2 - 1$, the remainder is $2x + 3$. Determine the values of 'a' and 'b'. **(5 marks)**

c) River Tana flows at a rate of 5 miles per hour .A petrol boat travels 40 miles upriver and returns to its original point in 6 hours. Determine the speed of the boat in still water. **(5 marks)**

Question THREE

a) Solve for θ in the following trigonometric equations: **(16 marks)**

$$\cos\theta - 7\sin\theta = 2$$
$$\cos(2\theta + 10°) + \cos(2\theta - 10°) = 0$$

b) A room 9 m wide has a span roof which slopes at 32° on one side and 41° on the other. Determine the length of the roof slopes. **(4 marks)**

Question FOUR

a) Express the following in partial fraction form: **(7 marks)**

$$\frac{5x^2 - 19x + 3}{(x-2)^2(x+1)}$$

b) The following simultaneous equations arise from experiments carried out on a system of forces:

$$F_1 + 3F_2 + 2F_3 = -13$$
$$2F_1 - 6F_2 + 3F_3 = 32$$
$$3F_1 - 4F_2 - F_3 = 12$$

Use elimination method to obtain F_1, F_2 and F_3. **(7 marks)**

c) If $f(x) = 4x^4 - 15x^2 + 5x + 6$:

i. Show that $(x + 2)$ is a factor of $f(x)$ **(3 marks)**

ii. Determine; **(3 marks)**

$$\frac{4x^4 - 15x^2 + 5x + 6}{x + 2}$$

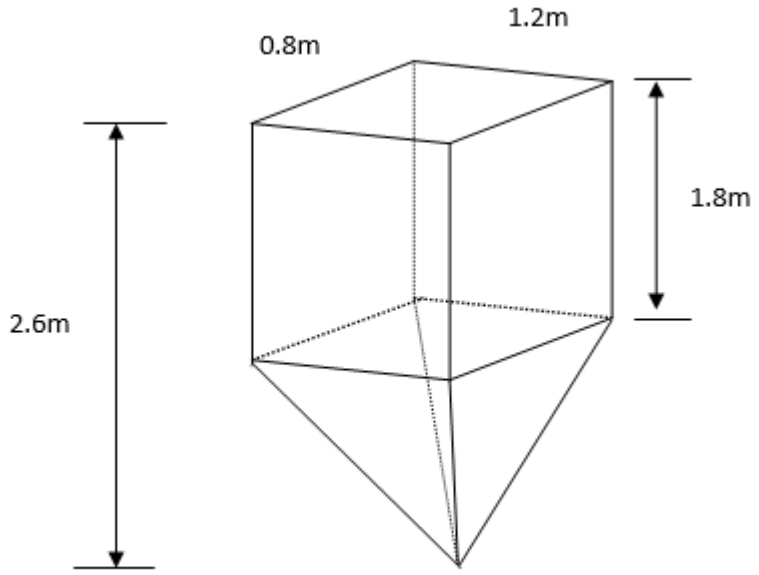
Question FIVE

a) When full, a swimming pool is 2 m deep at one end and 1.2 m deep at the other end. The pool is 15 m long and 5.5 m wide.

i. Sketch the swimming pool. **(2 marks)**

ii. Find the volume of the pool. **(5 marks)**

b) A grain storage bin is in the shape of a rectangular prism on top of a pyramid. If the total height of the bin is 2.6 m, determine its volume. **(5 marks)**



c) A community has a large rectangular room with a semi – cylindrical roof.

i. Find the area to one decimal of all the four walls and the roof given the floor measures 10 m by 18 m and the wall is 3 m high. **(5 marks)**

ii. Sketch room with the room **(3 marks)**