



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

SPECIAL/ SUPPLEMENTARY EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick Date Aug 2019

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID, Scientific calculator, a ruler

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

Do not write on the question paper.

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Question 1

- a) The tensions in a simple framework T_1 , T_2 and T_3 are given by the following set of simultaneous equations

$$6T_1 + 6T_2 + 6T_3 = 8.4$$

$$T_1 + 2T_2 + 4T_3 = 2.4$$

$$4T_1 + 2T_2 = 4.0$$

Determine T_1 , T_2 and T_3 elimination method

(7 Marks)

- b) Solve for $0 \leq x < 360^\circ$

The equation

$$3 \sin^2 x + 7 \sin x = \cos^2 x - 4$$

(5 Marks)

- c) Solve for x in the equations

i) $\log 12 + 3 \log x = \log 96$ without using calculators

(3 Marks)

ii) $8^{3x+2} = 5^{2x-7}$

(5 marks)

iii) Evaluate $\log_7 13$

(4 Marks)

- d) It takes a boat 3 hours to cruise 15Km upstream a river and back. If the river flows downstream at 2Km per hour. Determine the speed of the boat

(6 marks)

Question 2

- a) The current in amperes flowing through a capacitor at time t -seconds is given by

$$i = 8.0 \left(1 - e^{-t/CR} \right), \text{ where the circuit resistance } R = 25 \times 10^3 \text{ ohms and capacitance } C = 16 \times 10^{-6} \text{ farads.}$$

Determine the time to the nearest milliseconds it will take for the current to reach 6.0 Amperes.

(5 Marks)

- b) Solve for x in the equation

$$\log_x 3 - \frac{5}{2} \log_3 x = 2$$

(9 marks)

- c) Show that $\log_3(3x^2) = 1 + 2 \log_3 x$

Hence solve

$$1 + 2 \log_3 x = \log_3(28x - 9)$$

(6 Marks)

Question 3

- a) The displacement x -metres of a body from a fixed point about which it is oscillating is given by the following expression $x = 3.6 \sin 2t + 4.2 \cos 2t$, where t is the time in seconds. Express x in the form

$$R \sin(2t + \alpha)$$

(5 Marks)

- b) Prove the identity

$$\cos 3\theta = 4 \cos^3 \theta - 3 \cos \theta$$

(5 Marks)

c) Solve for x in the equation $\cos(x + 30^\circ) - \cos(x + 48^\circ) = 0.2$

$$0 \leq x \leq 360$$

(6 Marks)

- d) A pilot flies in a straight path for 1hr 30 minutes. She then makes a course correction heading 8° to the left of his initial path and flies for 2 hours in the new direction. If she maintains a constant speed of 450 miles per hour throughout the journey. Determine the distance of the plane from the origin (4 Marks)

Question 4

- a) Explain in partial fractions

$$\frac{x^3 + 7x^2 + 8x + 10}{x(x^2 + 2x + 5)}$$

(8 marks)

- b) The expression $ax^4 + bx^3 - x^2 + 2x + 3$ has a remainder of $3x+5$ when it is divided by $x^2 - x - 2$. Determine the value of 'a' and 'b' (6 Marks)

- c) Factorize the expression

$$3x^3 - 11x^2 - 19x - 5$$

Hence determine the roots of the equation

$$3x^3 - 11x^2 - 19x - 5 = 0$$

(6 Marks)

Question 5

- a) Sketch the graph for

$$\frac{x^2}{4} - \frac{y^2}{9} = 1$$

For values of x ranging from $x = -10$ to $x = +10$ at intervals of 2

(7 Marks)

- b) Show that the Cartesian equation for the polar equation

$$r = 4 \cos \theta \text{ is}$$

$$x^2 + y^2 = 4x$$

(4 Marks)

- c) A pyramid has a rectangular base 3.60cm by 5.40cm and sloping edges of 15.0 cm. Determine

- i) Its volume

(4 marks)

- ii) Total surface area

(5 marks)