



MURANG'A UNIVERSITY COLLEGE

(A Constituent college of Jomo Kenyatta University of Agriculture and Technology)

SEM 1207: ENGINEERING MATHEMATICS IV

INSTRUCTIONS: Answer Question ONE and other Two Questions Time 2 hours

QUESTION ONE (30 Marks Compulsory)

a) Given that $A = \begin{pmatrix} 4 & 0 \\ 0 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} a & b \\ 0 & c \end{pmatrix}$ and that $AB = A+B$, find a, b and c (5 marks)

b) Solve the following system of linear equations using cramers law (7 marks)

$$x + 2y + z - 2 = 0$$

$$3x - 4y + 3z + 4 = 0$$

$$5x + 3y + 5z = -1$$

c) Find the inverse of $f(x) = \frac{1}{8}x^3 + 1$ hence find $f^{-1}(9)$ (6 mark)

d) Determine the value of $\coth 0.38$ (4 marks)

e) A telegraph wire hangs so that its shape is described by $y = 50 \cosh \frac{x}{50}$ Evaluate the value of y when $x = 25$ (4 marks)

f) Two times Joe's age minus Mary's age minus three equal to zero. Eight times Mary's age equal to seven times Joe's age plus two. Using matrix algebra, solve for Joe's and Mary's age (4 marks)

QUESTION TWO (20 Marks)

a) Determine the power series for $\cos 2\theta$ (6 marks)

b) Using Maclaurin's Series, find the first five terms for the expansion of the function $f(x) = e^{3x}$ (7 marks)

c) Prove that Taylor series expansion of $f(x) = \cos z$ about the point $z = \frac{\pi}{3}$ is $\frac{1}{2} \left(1 - \sqrt{3} \left(z - \frac{\pi}{3} \right) - \frac{\left(z - \frac{\pi}{3} \right)^2}{2!} + \frac{\sqrt{3} \left(z - \frac{\pi}{3} \right)^3}{3!} - \frac{\left(z - \frac{\pi}{3} \right)^4}{4!} - \dots \right)$ (7 marks)

QUESTION THREE (20 Marks)

- a) A chain hangs in the form given by $y = 40 \operatorname{ch} \frac{x}{40}$. Determine:
 i. The value of y when $x = 25$ (4 marks)
 ii. The value of x when $y = 54.30$ (8 marks)
- b) Determine the values of p_1, p_2 and p_3 using inverse method given that

$$\begin{aligned} p_1 + 3p_2 + 3p_3 &= 32 \\ p_1 + 4p_2 + 3p_3 &= 37 \\ p_1 + 3p_2 + 4p_3 &= 35 \end{aligned}$$

(8 marks)

QUESTION FOUR (20 Marks)

- a) Expand $\ln(1 + x)$ to five terms (7 marks)
- b) Evaluate in radians correct to 3 decimal places
 i. $\arcsin(0.30) + \arccos(0.65)$ (4 marks)
 ii. $\sin^{-1} \frac{1}{3} + \cos^{-1} \frac{4}{5} - \tan^{-1} \frac{8}{9}$ (4 marks)
- c) Find the inverse of $y = x^2 + 1$ and comment on your answer (5 marks)

QUESTION FIVE (20 Marks)

- a) If $4e^x - 3e^{-x} = P \operatorname{sh} x + Q \operatorname{ch} x$, determine the values of P and Q (8 Marks)
- b) Find the inverse of $y = \frac{1}{2}x + 1$ (2 marks)
- c) A company manufactures three products x, y and z each of which must go through three processes A, B and C for the following times.

Product	Time spent in Processes		
	A	B	C
X	3	2	1
Y	3	2	3
Z	2	0	1

The maximum capacities of processes A, B and C are 130, 85 and 60 respectively. Using the inverse matrix method, calculate the number of units to be produced of products x, y and Z to ensure utilization of maximum capacity. (10 Marks)

