MURANG'A UNIVERSITY COLLEGE

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

University Examination 2014/2015

Special/Supplementary Examination for the Diploma in Mechanical Engineering

SEM 1207: ENGINEERING MATHEMATICS IV

Date: October 2015 2 Hours

Instructions: Attempt Question **One** and any other **Two** Questions.

Question One (30 Marks)

a) Given the matrices

$$A = \begin{pmatrix} 1 & 3 \\ -5 & 2 \\ 0 & 6 \end{pmatrix} \text{ and } B = \begin{pmatrix} 3 & -4 & -2 \\ 1 & 2 & 7 \end{pmatrix}$$

show that AB is a singular matrix (5 Marks)

b) Given the two matrices

$$A = \begin{pmatrix} 1 & 0 & 5 \\ 2 & -1 & 4 \\ 3 & -2 & 1 \end{pmatrix} \text{ and } B = \begin{pmatrix} 7 & -10 & 5 \\ 10 & -14 & 6 \\ -1 & 2 & -1 \end{pmatrix}$$

Find the matrix product AB hence determine A^{-1} (4 Marks)

c) Obtain the first three non-zero terms of the Maclaurin's series expansion for $f(x) = sinh(x)$ (5 Marks)

d) Given the function $f(x) = 2x + 3$, find $f^{-1}(x)$ hence verify that $(f \circ f^{-1})(x) = x$ (5 Marks)

e) Evaluate $Sinh(3 + 5j)$ (6 Marks)

f) Express $tanh^{-1}(x - 2)$ in terms of logarithms (5 Marks)

Question Two (20 Marks)

a) Obtain the first 4 non-zero terms of the Taylor's series expansion for $f(x) = ln(x)$ about $x = 1$ (5 Marks)

b) Find the values of x that satisfy the equation $cosh(x) - 5sinh(x) - 7 = 0$ (8 Marks)

c) Given that the matrix A below is singular, find the possible values of x

$$A = \begin{pmatrix} 4 & -1 & 3 \\ x & 2 & 5 \\ 7 & -1 & x \end{pmatrix}$$ (7 Marks)

Question Three (20 Marks)

a) Obtain the first three non-zero terms of the Maclaurin's series for $sin(x)$ hence evaluate $\int_0^1 \frac{sin(x)}{\sqrt{x}} dx$ (10 Marks)

b) Given that $cos(45^0) = sin(45^0) = \frac{1}{\sqrt{2}}$, use the first three terms of a suitable Taylor,s series to find the value of $cos(44^0)$ correct to 4 decimal places. (10 Marks)

Question Four (20 Marks)

a) Find the inverse of the matrix

$$A = \begin{pmatrix} 1 & 4 & -1 \\ -7 & 2 & 3 \\ 8 & -5 & 9 \end{pmatrix}$$ (9 Marks)

b) Use Cramer's rule to find the solution to the linear system of equations

$x - 2y + 3z = -11$

$3x + y - 2z = 10$

$4x - 3y - 5z = 5$ (11 Marks)

Question Five (20 Marks)

a) Given that $Me^x + Ne^{-x} = 2cosh(x)_5 sinh(x)$ for all values of x. Determine the values of M and N (4 Marks)

b) Prove that $coth^{-1}(x) = \frac{1}{2} ln \left| \frac{x+1}{x-1} \right|$ for $|x| > 1$
hence find the value of $coth^{-1}(1.2)$ (7 Marks)

c) Solve the equation $3cosh(2x) - sinh(x) = 1$ (9 Marks)