THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

INSTITUTIONAL BASED PROGRAMME

DIPLOMA IN MECHANICAL ENGINEERING (PRODUCTION)
DIPLOMA IN AUTOMOTIVE ENGINEERING

ENGINEERING MATHEMATICS V

SERIES: NOVEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

This paper consists of **FIVE** questions

- *Answer Booklet*
- *Mathematical Table/Scientific Calculator*
- *Drawing Instruments*
- *Abridged Laplace Transforms Table*

Answer question **ONE (COMPULSORY)** in **SECTION A** and any other **TWO** questions in **SECTION B**

Marks are indicated for each part of the question

This paper consists of **THREE** printed pages

QUESTION ONE

a) Sketch at least three periods of each of the following functions stating whether the functioned odd, even or neither giving reasons for your answer.

$$f(x)=\begin{cases}1, -\pi \le x \le 0\\ x, \quad 0 \le x \le \pi\end{cases}$$

i)

$$f(x)=x, -\pi \le x \le \pi$$

ii)

$$f(x)=\begin{cases}-x, -\pi \le x \le 0\\ x, \quad 0 \le x \le \pi\end{cases}$$

iii) (9marks)

$$f(x)=x^2, -\pi \le x \le \pi$$

b) Sketch the function and show that the Fourier series for the function

$$f(x)=x^2, -\pi \le x \le \pi$$

$$f(x)=x^2=\frac{\pi^2}{3}+4\sum_{n=1}^{\infty}(-1)^n\frac{\cos nx}{n^2}$$

may be given by (11marks)

QUESTION TWO

$$A=\begin{bmatrix}1 & 2 & 3\\ -2 & 1 & 2\\ 3 & -1 & -1\end{bmatrix} \qquad B=\begin{bmatrix}1 & -1 & 1\\ 4 & -10 & -8\\ -1 & 7 & 5\end{bmatrix}$$

a) Given that and

i) Determine the product AB

ii) Hence solve the following simultaneous equations

$$x+2y+3z=-6$$
$$-2x+y+2z=1$$
$$3x-y-z=1$$

(8marks)

b) Use Crammers rule to solve the simultaneous equation

$$2x+3y+z=8$$
$$3x-5y-2z=4$$
$$5x+2y-42=-7$$

(12marks)

QUESTION THREEA

$$f(x)=\begin{cases}-\cos x, & -\pi \le x \le 0\\ \cos x, & 0 \le x \le \pi\\ f(x+2\pi)\end{cases}$$

A function is defined by

i) Sketch the function for at least 3 periods.
ii) State whether the function is odd. even or neither. Give reason for your answer

$$\frac{\pi\sqrt{2}}{16}=\frac{1}{1\times 3}-\frac{1}{5\times 7}+\frac{1}{9\times 11}\text{L}$$

iii) Find the Fourier series hence show that

QUESTION FOUR

$$A=\begin{bmatrix}14 & 9 & 33\\ 13 & 11 & 36\\ 17 & 2 & 22\end{bmatrix} \qquad B=\begin{bmatrix}1 & 3 & 5\\ 2 & 4 & 6\\ 3 & 5 & 7\end{bmatrix}$$

(a) Given the matrices ,

$$\det(AB)=\det A.\det B$$

i) Show that
ii) Determine the inverse of AB. (6marks)

$$A=\begin{bmatrix}2 & 1 & -1\\ 1 & -2 & 3\\ -2 & 1 & 2\end{bmatrix} \qquad B=\begin{bmatrix}1 & -1 & 2\\ -2 & 1 & 3\\ 2 & -1 & 1\end{bmatrix}$$

(b) Given the matrices ,

$$(A+B)^2=A^2+AB+BA+B^2$$

Show that (7marks)

c) A certain manufacturing company is trying to promote its sales, in the area of public transport. It sells 3 rims, 2tyres and a tube for Kshs. 91000; 4 rims, a tyre and 2 tubes for Kshs. 110,000 while a rim ,3tyres and 2 tubes costs Kshs.54000.Use crammers rule to determine the cost of each of the three accessories. (7marks)

QUESTION FIVE

a) (i) Express as a single matrix ,where

$$3A+2B-C$$

$$A=\begin{bmatrix}a & 0\\ 0 & a\end{bmatrix},B=\begin{bmatrix}0 & b\\ b & 0\end{bmatrix},C=\begin{bmatrix}1 & 1\\ 1 & c\end{bmatrix}$$

, Hence find the value of a, b and c

$3A + 2B - C = 0$

if

(3marks)

$$A = \begin{bmatrix} 1-x & 3 \\ 3 & 1-x \end{bmatrix}$$

ii) Given the matrix .Give the two singular matrices (2marks)

$$f(x) = -x, \quad -1 \le x \le 1$$

b) Determine the Fourier series for the function define
Hence sketch the function for at least three periods (9marks)

$$A = \begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 1 \\ 2 & 2 & 1 \end{bmatrix}$$

$P = A^2 + 3A$

c) Given the matrix (i) evaluate

$$15x + 23y + 9z = 3$$
$$9x + 15y + 7z = -5$$
$$14x + 18y + 8z = 0$$

P^{-1}

(ii) Find and hence solve (11marks)