



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.

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

i)

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

ii)

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

iii)

(9marks)

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

- b) Sketch the function

and show that the Fourier series for the function

$$f(x) = x^2, -\pi \leq x \leq \pi \quad \text{may be given by} \quad f(x) = x^2 = \frac{\pi^2}{3} + 4 \sum_{n=1}^{\infty} (-1)^n \frac{\cos nx}{n^2}$$

(11marks)

QUESTION TWO

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

- 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

$$\begin{aligned} 2x + 3y + z &= 8 \\ 3x - 5y - 2z &= 4 \\ 5x + 2y - 4z &= -7 \end{aligned}$$

(12marks)

QUESTION THREEA

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

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

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

- iii) Find the Fourier series hence show that

QUESTION FOUR

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

- (a) Given the matrices ,

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

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

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

- (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 $3A + 2B - C$,where

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

, 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)

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

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

$$15x + 23y + 9z = 3$$

$$9x + 15y + 7z = -5$$

$$14x + 18y + 8z = 0$$

(ii) Find P^{-1} and hence solve (11marks)