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**TECHNICAL UNIVERSITY OF MOMBASA**  
**FACULTY OF APPLIED AND HEALTH SCIENCES**  
**DEPARTMENT OF MATHEMATICS & PHYSICS**  
**UNIVERSITY EXAMINATION FOR:**  
**INSTITUTION BASED**

**DIPLOMA IN MECHANICAL, ELECTRICAL, BUILDING AND CIVIL**  
**ENGINEERING YEAR II SEMESTER I**  
**AMA 2250: ENGINEERING MATHEMATICS III**  
**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2017**

**TIME: 2 HOURS**

**DATE: Pick Date Apr 2017**

**Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID Mathematical table, calculator*

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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- Q.1 (a) Use the method of determinants to solve the following set of simultaneous equations:
- $$\begin{aligned} 11p + 7q + 2r &= 31 \\ p + q + r &= 4 \\ 31p + 15q + 13r &= 90 \end{aligned}$$
- (12 marks)
- (b) Use Maclaurn's theorem to obtain the power series for the function.  
 $f(x) = \text{Cos}^2 x$  upto the third term. (6 marks)
- (c) (i) Use Taylor Series to determine the power series for  
 $\text{Cos}(x+h)$   
(ii) Use the power series for  $\text{Cos}(x+h)$  in C(i) to obtain the value of  
 $\text{Cos}46^\circ$  correct to four decimal places. (6 marks)
- (d) Given  $P = 2i + j - k$  and  $q = i - j + k/2$   
Determine (i)  $p \cdot q$   
(ii)  $p \times q$  (6 marks)
- Q.2 (a) Derive Maclauriu's Series. (5 marks)
- (b) Determine the first five terms of series.  
(i)  $f(x) = \text{Log}_e(1+x)$   
(ii)  $f(x) = \text{Cos}x$  (10 marks)
- (c) Find the first four terms of the function.  
 $f(x) = (x-1)e^x$  near  $x=1$   
Using Tayolor series. (5 marks)
- Q.3 (a) Given  $A = \begin{pmatrix} 1 & 3 & -1 \\ -2 & 2 & 4 \\ 3 & 1 & 3 \end{pmatrix}$  and  $B = \begin{pmatrix} 2 & 3 & 1 \\ 3 & -1 & 1 \\ 3 & 2 & 0 \end{pmatrix}$   
Obtain (i)  $A \times B$   
(ii)  $2A + B$  (5 marks)
- (b) Determine the value of the determinant of the matrix.

$$A = \begin{pmatrix} 3 & -1 & 2 \\ 2 & 3 & 1 \\ 2 & 1 & 4 \end{pmatrix} \quad (3 \text{ marks})$$

- (c) The tensions in a simple framework,  $T_1$ ,  $T_2$ , and  $T_3$  are given by the equations:

$$12T_1 + 12T_2 + 12T_3 = 16.8$$

$$2T_1 + 4T_2 + 8T_3 = 4.8$$

$$8T_1 + 4T_2 = 8.0$$

Use the inverse matrix method to determine the value of  $T_1$ ,  $T_2$  and  $T_3$  (12 marks)

- Q.4 (a) A worker at a factory is stacking cylindrical-shaped pipes which are stacked in layers. Each layer contains one pipe less than the layer below it. There are 4 pipes in the top most layer. If there are  $n$  layers in total.

Determine the expression for total number of pipes stacked. (5 marks)

- (b) A business is expected to have a yearly profit of Kshs.275000 for the year 2016. The profit is expected to increase by 10% per year;

(i) Show that the difference between expected profit for the year 2020 and the expected profit in 2021 is Kshs.40300 to the nearest hundred shillings. (3 marks)

(ii) Find the total expected profits for the year 2016 to 2026 inclusive giving your answer to the nearest hundred shillings. (3 marks)

- (c) The sum of the first six terms of an arithmetic progression is 21, and the seventh term is three times the sum of the third and the fourth term.

Determine: (i) The first term  
(ii) The common ratio. (5 marks)

- Q.5 (a) A canoe sails directly across a river at 4 m/s. The river flows at 2.4 m/s and is 720 metres wide.

(i) Determine the resultant velocity of the boat.  
(ii) How far down stream is the canoe's landing point? (6 marks)

- (b) Two anchors are holding a ship in place and their forces acting on the ship are represented by vectors A and B as follows:-

$$A = 3i + 5j - 2k \text{ and}$$

$$B = 2i - 3j + 4k$$

If we are to replace the two anchors with a single anchor determine the vector representing the single vector. (2 marks)

(c) If  $\vec{a} = (2, 1, -3)$  and  $\vec{b} = (-4, 4, -2)$   
Obtain  $\vec{a} \times \vec{b}$  (4 marks)

(d) Determine the angle between the vectors  $P = 2i + 7k$  and  $Q = -2i + 2j + 4k$ . (8 marks)