



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN MECHANICAL, ELECTRICAL, BUILDING AND CIVIL ENGINEERING YEAR II

SEMESTER I

AMA 2250: ENGINEERING MATHEMATICS III

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2016

TIME: 2HOURS

DATE: 8 December 2016

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.

QUESTION ONE [30MKS]

a) Use Maclaurin's theorem to derive the power series for the following functions:

i. $f(x) = \sin x$ [5mks]

ii. $f(x) = xe^x$ [5mks]

b) Given matrix $A = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 2 \\ 1 & 0 & 3 \end{pmatrix}$ and matrix $B = \begin{pmatrix} 1 & 1 & 4 \\ 3 & 1 & 2 \\ 0 & 2 & 4 \end{pmatrix}$ find:

i. BA^T [4mks]

ii. A^{-1} [6MKS]

c) Test if the series $\sum_{n=0}^{\infty} \frac{(100+75i)^n}{n!}$ Converges or diverges [4mks]

(d) Given vector $\mathbf{P} = 3\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and vector $\mathbf{Q} = \mathbf{i} - 2\mathbf{j} + \mathbf{k}$. Determine if the vectors P and Q are orthogonal (6mks)

QUESTION TWO

a) Derive the Maclaurin's Series (5 marks)

b) Derive the power series for $f(x) = \sin x$ hence evaluate $\sin 1.4$ to 4dp [10mks]

c) Use Taylor series to find the first four terms of the function $f(x) = (x - 2)e^x$ near $x=2$ [5mks]

QUESTION THREE

a) Given $A = \begin{pmatrix} 1 & 0 & -1 \\ -2 & 0 & 4 \\ 3 & 1 & 5 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 0 & 0 \\ 1 & -1 & 0 \\ 5 & 3 & 2 \end{pmatrix}$

Evaluate (i) $A^T B$ [5mks]

(ii) Determinant of matrix A and B [3mks]

b) The tensions in a simple framework, T_1 , T_2 , and T_3 are given by the equations:

$$T_1 + T_2 + 3T_3 = 12$$

$$T_1 + 2T_2 + 4T_3 = 17$$

$$4T_1 + 2T_2 + T_3 = 11$$

Use the inverse matrix method to determine the value of T_1 , T_2 and T_3

[10MKS]

QUESTION FOUR

a) Find the sum of the first 20 natural numbers starting from 10 [4mks]

b) The sums of the series

$$\sum_{n=0}^{\infty} \frac{2^n}{n!} \quad [5mks]$$

- c) Find the sum to infinity of the series

$$\sum_{n=0}^{\infty} \frac{8}{2^n}$$

[5mks]

- d) Find the value of K if the matrix $B = \begin{pmatrix} 1 & k & 0 \\ 1 & -1 & 0 \\ 2 & 3 & 2 \end{pmatrix}$ is a singular matrix [4mks]

QUESTION FIVE

- a) A motor boat sails directly across a river at 4.0 m/s. The river flows at 3 m/s and it is 600m wide.
- Determine the resultant velocity of the boat. [3mks]
 - How far down stream is the boat's landing point? [3mks]
- b) Two beams are holding a suspended heavy container in place and their forces acting on the ship are represented by vectors R and T as follows:-

$$R = 4i + 5j - 4K \text{ and}$$

$$T = 4i - 3j - 5k$$

Determine a single force that can replace the two beams

[3mks]

- c) If $\vec{A} = (1, 1, 2)$ and $\vec{B} = (2, 4, -1)$ determine the cross product of vector \vec{A} and \vec{B} [3mks]

- d) Determine the acute angle between the vectors $P = 2i + 2j + K$ and $Q = 2i + 3j + 3K$.

[8 mks]