



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN MEDICAL ENGINEERING

AMA2250: ENGINEERING MATHEMATICS III

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: 11 Dec 2016

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Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE (COMPULSORY)

(a) Write down the following expansions of the determinant

$$|C| = \begin{vmatrix} 3 & 1 & -2 \\ 1 & 0 & 2 \\ -3 & -1 & 4 \end{vmatrix}$$

- | | | | |
|-------|---------------------------|------|---------------|
| (i) | By first row | (ii) | By second row |
| (iii) | By 3 rd column | (iv) | By last row |

and check that they all lead to the same result. (10 marks)

(b) If $\mathbf{a} = 2\mathbf{i} + 4\mathbf{j} - 5\mathbf{k}$ and $\mathbf{b} = 3\mathbf{i} - 2\mathbf{j} + 6\mathbf{k}$ determine:

- | | | | |
|-----------------------------------|----------------------------------|--------------------------------------|------------------------------------------------------|
| (i) $\mathbf{a} \cdot \mathbf{b}$ | (ii) $ \mathbf{a} + \mathbf{b} $ | (iii) $\mathbf{a} \times \mathbf{b}$ | (iv) the angle between \mathbf{a} and \mathbf{b} |
|-----------------------------------|----------------------------------|--------------------------------------|------------------------------------------------------|

(14 marks)

(c) Two impedances, $z_1 = (2 + j7)$ ohms and $z_2 = (3 - j4)$ ohms, are connected in series to a supply voltage V of $150 \angle 0^\circ V$. Determine the magnitude of the current I and its phase angle relative to the voltage.

(6 marks)

Question TWO

(a) State any FIVE properties of determinants. (5 marks)

(b) For the system of equations

$$2x + 3y + z = 9$$

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

$$3x + y + 2z = 8$$

compute the unknowns x, y and z using the inverse matrix method. (15 marks)

Question THREE

(a) Evaluate, in polar form $2 \angle 30^\circ + 5 \angle -45^\circ - 4 \angle 120^\circ$ (8 marks)

(b) Use Cramer's rule to solve the equations:

$$3x + 2y - z = 0$$

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

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

(12 marks)

Question FOUR

(a) State whether the following are scalar or vector quantities:

i). A temperature of 50°C

ii). A downward force of 80N

iii). A south-westerly wind of 15 knots

iv). An acceleration of 25m/s^2 at 30° to the horizontal (4 marks)

(b) If $z = 2\left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)$ and $w = 3\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$, find the polar form of:

i). zw

ii). $\frac{z}{w}$

iii). $\frac{w}{z}$

iv). $\frac{z^5}{w^2}$

(11 marks)

(c) Given that $C = [2 \ 3 \ 4]$ and $D = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$, Compute the products $C \cdot D$ and $D \cdot C$

(5 marks)

Question FIVE

(a) Find the rational number k for which the matrix $A = \begin{bmatrix} 1 & 2 & k \\ 3 & -1 & 1 \\ 5 & 3 & -5 \end{bmatrix}$ is singular.

(4 marks)

(b) Let $z_1 = 5 + 2i$, $z_2 = 1 + 3i$, $z_3 = 2 - 3i$, $z_4 = -4 - 7i$.

i). Plot the complex numbers z_1, z_2, z_3, z_4 on an Argand diagram and label them

ii). Plot the complex numbers $z_1 + z_2$ and $z_1 - z_2$ on the same Argand diagram. Geometrically, how do the positions of the numbers $z_1 + z_2$ and $z_1 - z_2$ relate to z_1 and z_2 ?

(16 marks)