



TECHNICAL UNIVERSITY OF MOMBASA
Faculty of Applied & Health
Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

CERTIFICATE IN ELECTRICAL POWER ENGINEERING (CEPE III)

AMA 1251: MATHEMATICS I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2014

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Calculator*

This paper consist of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown
 This paper consists of **THREE** printed pages

Question One (Compulsory)

- a) Given $\vec{a} = 3\hat{i} - 9\hat{j} + \hat{k}$ and $\vec{b} = -\hat{i} + 8\hat{k}$ determine:
- (i) $2\vec{a} - 3\vec{b}$ (3 marks)
 - (ii) $\vec{a} \cdot \vec{b}$ (2 marks)
 - (iii) $\vec{a} \times \vec{b}$ (3 marks)
- b) (i) Evaluate $\frac{-4}{j^9}$ (4 marks)
- (ii) Convert $4 < 30^\circ$ into rectangular form of a complex number. (3 marks)
- c) Expand $\left(c - \frac{1}{c}\right)^5$ using the binomial series. (5 marks)

Question Two

- a) (i) Determine the value of $(3.039)^4$ correct to 6 significant figures using the binomial theorem. (5 marks)
- (ii) Simplify $\frac{3\sqrt{1-3x} \sqrt{1+x}}{\left(1 + \frac{x}{2}\right)^3}$ given that powers of x above the first power may be neglected. (5 marks)
- b) In how many ways can the letter of the word STATISTICS be arranged? (3 marks)
- c) In how many ways 10 members of a committee can be seated at a round table if:
- (i) They can sit anywhere
 - (ii) President and secretary must not sit next to each other. (5 marks)

Question Three

- a) Determine $(-2 + j3)^6$ (6 marks)
- b) Determine the two square roots of the complex number $(5 + j12)$:
- (i) In polar form (7 marks)

- (ii) In Cartesian form (4 marks)
 (iii) Show the roots on a Argand diagram (3 marks)

Question Four

- a) Determine whether the three vectors lie on the same plane:

$$\hat{t} = \hat{i} + 4\hat{j} - 7\hat{k} \quad \hat{u} = 2\hat{i} - \hat{j} + 4\hat{k} \quad \hat{w} = -9\hat{j} + 18\hat{k}$$

and (5 marks)

- b) Determine whether the following pair of vectors are parallel or not:

$$\hat{a} = -2\hat{i} - 4\hat{j} + \hat{k}, \quad \hat{b} = -6\hat{i} + 12\hat{j} - 3\hat{k}$$

(i) (2 marks)

$$\vec{r} = 4\hat{i} + 10\hat{j} \quad \vec{w} = 2\hat{i} + 9\hat{j}$$

(ii) (2 marks)

$$\vec{t} = 3\hat{i} - 4\hat{j} - \hat{k} \quad \vec{u} = 5\hat{j} + 2\hat{k}$$

- c) (i) Determine the angle between \vec{t} and \vec{u} (6 marks)

- (ii) A plane contains the points P(1,0, 0), Q(1, 1, 1) and R(2, -1, 3) determine a vector that is perpendicular to this plane. (5 marks)

Question Five

$$(2p - 3q)^5$$

- a) Use Pascal's triangle to expand (5 marks)

- b) Evaluate the following in polar form:

$$\frac{16 \angle 75^\circ}{2 \angle 15^\circ}$$

(i) (2 marks)

$$\ln Z \quad \text{where } z = 4e^{j1.3}$$

(ii) (4 marks)

$$(5 + j3)^{\frac{1}{2}}$$

- c) Determine the root of $(5 + j3)^{\frac{1}{2}}$ in rectangular form correct to 4 s.f. (9 marks)