



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

## *Faculty of Engineering & Technology*

### DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

### CERTIFICATE TECHNICIAN I

### SEMESTER I EXAMINATION

### APRIL/MAY 2010 SERIES

## **AH 2101 : ALGEBRA**

**TIME: 2 HOURS**

### **Instructions to Candidates**

You should have the following for this examination:

- Answer booklet
- Mathematical tables
- Non-programmable calculator

This paper consists of **FIVE** Questions.  
Answer Question **ONE COMPULSORY**  
And any other **TWO** Questions.

**Question ONE (30 Marks) COMPULSORY**

- (a). (i). Solve for  $x$  correct to 4 s.f.  $2^x = 3$  **(4 Marks)**  
(ii). Simplify,  $\log 64 - \log 128 + \log 32$  **(3 Marks)**
- (b). (i). Solve by factorization,  $10x^2 - 3x - 4 = 0$  **(4 Marks)**  
(ii). Determine the values of  $x$  and  $y$ , which simultaneously satisfy the equations:  $y = 5x - 4 - 2x^2$  and  $y = 6x - 7$  **(5 Marks)**
- (c). (i). Evaluate,  $(1 + i)^4$ . **(3 Marks)**  
(ii). Simplify,  $\left(\frac{1}{16}\right)^{-\frac{3}{2}}$  **(3 Marks)**
- (d). (i). How many permutations are there of the letters in the word, Mississippi? **(4 Marks)**
- (e). The second term of an arithmetic progression is 15 and the fifth term is 21. Find;  
(i). The first term  
(ii). The common difference **(4 Marks)**

**Question TWO (20 Marks)**

- (a). In a geometrical progression, the sum of the second and third terms is 9, and the seventh term is eight times the fourth. Find:  
(i). The first term  
(ii). The common ratio and  
(iii). The fifth term **(9 Marks)**
- (b). Find the coefficient of  $x^3$  in the expansion of  $(1 + i)^7$ . **(4 Marks)**
- (c). In how many ways can 11 players be selected from 13 for a soccer team.  
(i). If no places have yet been filled?  
(ii). If seven places have already been filled? **(7 Marks)**

**Question THREE (20 Marks)**

- (a). (i). Evaluate,

$$i\left(\frac{1+3i}{1-2i}\right)^2 \quad \text{(6 Marks)}$$

- (ii). Solve the quadratic equation,  $4x^2 - 7x + 2 = 0$  by using the quadratic formula, giving your answer correct to 2 decimal places. **(4 Marks)**

- (iii). Solve the following system of linear equations for  $x$ ,  $y$  and  $z$ .

$$3x + 2y - z = -1$$

$$x + y + z = 6$$

$$3x + y + 2z = 15$$

**(10 Marks)**

**Question FOUR (20 Marks)**

- (a). Prove by induction, that,  $a + ar + ar^{n-1} = a\left(\frac{1-r^n}{1-r}\right)$  **(8 Marks)**

- (b). (i). Determine the roots of the following complex numbers in polar and Cartesian form;

$$(-6 - i5)^{1/2} \quad \text{(8 Marks)}$$

- (ii). Write  $\log\left(\frac{8 \times 4\sqrt{5}}{81}\right)$  in terms of  $\log 2$ ,  $\log 3$  and  $\log 5$  to any base.

**(4 Marks)**

**Question FIVE (20 Marks)**

- (a). Obtain the first four terms of the expansion of  $\left[1 + \frac{1}{2}x\right]^{10}$  in ascending powers of  $x$ . Hence find the value of  $(1.005)^{10}$ , correct to four decimal places. **(10 Marks)**

- (b). The resistance  $R$  of an electrical conductor at temperature  $0^\circ\text{C}$  is given by  $R = R_0 e^{\alpha\theta}$  where  $\alpha$  is a constant and  $R_0 = 5 \times 10^3$  ohms. Determine the value of  $\alpha$  is a constant and  $R = 6 \times 10^3$  ohms, and  $\theta = 1500^\circ\text{C}$ . Also, find the temperature correct to the nearest degree, when the resistance is  $5.4 \times 10^3$  ohms. **(10 Marks)**