



# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR DEGREE OF  
BACHELOR OF TECHNOLOGY (ELECTRICAL)**

AMM 118 – ENGINEERING MATHEMATICS II

DURATION: 2 HOURS

DATE: 20<sup>TH</sup> APRIL, 2018

TIME: 2.00 – 4.00 P.M.

### **Instructions to Candidates:**

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

## SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

### QUESTION ONE

- a) Define the following terms as used in set theory
- The intersection of sets A and B (1 mark)
  - An empty set (1 mark)
- b) Show that the terms of  $\sum_{r=1}^n \text{Log}5^r$  are in AP and find the sum of the first 20 terms of the series (4 marks)
- c) Given  $z_1 = 6 - 5i$  and  $z_2 = -3 + 4i$  show that  $|Z_1 + Z_2| \leq |Z_1| + |Z_2|$  (4 marks)
- d) Given that  $\begin{pmatrix} a + b & 2c + d \\ a - b & c - d \end{pmatrix} = \begin{pmatrix} 4 & 6 \\ 2 & 3 \end{pmatrix}$  solve for a,b,c and d (4 marks)
- e) Solve the following simultaneous equations using the matrix method
- $$2x + 3y = 13$$
- $$X - 2y = 4$$
- (4 marks)
- f) Consider the following universal set U defined as  $U = \{1,2,3,4,5,6,7,8,9,10\}$ . Consider other three sets A, B and C defined by  $A = \{1,3,4,5\}$   $B = \{4,5,6,2\}$  and  $C = \{2,1,5,7,10\}$  show that
- $$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$$
- (3 marks)
- g) Evaluate  $\frac{(\cos \pi/3 + i \sin \pi/3)^{11}}{(\cos 4/3\pi + i \sin 4/3\pi)^7}$  (3 marks)
- h) Determine 4 terms between 4 and 128 which together form a geometric sequence (3 marks)
- i) Show that  $a*b = 1+ab$  is commutative but not associative (3 marks)

## SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

### QUESTION TWO

- a) A survey of 500 students showed that 300 of them have been to Nairobi city, 50 to Mombasa city and 200 to Kisumu city; 40 to Mombasa and Kisumu, 10 to Nairobi and Mombasa, 150 to Kisumu and Nairobi and 8 have been to all the three cities. Determine how many of the students have been to
- None of the three cities (3 marks)
  - Exactly one of the cities (3 marks)
  - At least two cities (3 marks)
  - Nairobi only (1 mark)

- b) Use row operation to find the inverse of matrix X given  $X = \begin{pmatrix} 1 & 1 & -5 \\ -1 & -2 & 4 \\ 2 & 7 & -3 \end{pmatrix}$  (5 marks)

Use Cramer's rule to solve the system

$$x_1 + 2x_2 + 3x_3 = 5$$

$$4x_1 + 5x_2 + 6x_3 = 14$$

$$5x_1 + 7x_2 + 8x_3 = 17 \quad (5 \text{ marks})$$

### QUESTION THREE

- a) Define a symmetric matrix and hence find the values of w,x,y and z if the matrix A is symmetric

$$A = \begin{pmatrix} 2 & 6 & 9 \\ w & y & z \\ x & 7 & 3 \end{pmatrix} \quad (4 \text{ marks})$$

- b) Use Gaussian Jordan elimination method to find the solutions to system

$$x_1 + 2x_2 - 3x_3 = -16$$

$$2x_1 + 6x_2 - 5x_3 = -34$$

$$3x_1 - 2x_2 + 4x_3 = 28 \quad (6 \text{ marks})$$

- c) Find the rank of the matrix B given  $B = \begin{pmatrix} 1 & 6 & 1 & 2 & 0 \\ -1 & 0 & 2 & 1 & 0 \\ 0 & 0 & 2 & 0 & 1 \\ 1 & 2 & 1 & 0 & 1 \\ 1 & 4 & 2 & 1 & 1 \end{pmatrix}$  (4 marks)

- d) Find the least number of terms of the G.P  $2+6+18+54+\dots$  that must be taken in order that the sum exceeds 125,000 (6 marks)

### QUESTION FOUR

- a) Find out the eigen values and basis of eigen space given the matrix  $C = \begin{pmatrix} -3 & 1 & -1 \\ -7 & 5 & -1 \\ -6 & 6 & -2 \end{pmatrix}$  (6 marks)

- b) Let  $T = \{(x,y) \mid x,y \in \mathbb{R}\}$  Define \* on T by  $(x,y)*(z,w) = (x+yz, yw)$

i. Is T closed under \* (1 mark)

ii. Is \* commutative on T (2 marks)

iii. Is \* Associative on T (2 marks)

iv. Does \* admit identity element in T (3 marks)

v. Does \* admit inverse in T (3 marks)

c) Evaluate of  $\sum_{n=1}^{10} (3/4)^n$  (3 marks)

### QUESTION FIVE

a) Use De Moivres theorem to show that  $\sin 4\theta = 4\cos^3\theta\sin\theta - 4\cos\theta\sin^3\theta$  (4 marks)

b) Solve for x and y given  $\left(\frac{1+i}{1-i}\right)^2 + \frac{1}{x+iy} = 1 + i$  (5 marks)

c) Using the definition of exponential function prove  $|e^{iz}| = e^{-y}$  (3 marks)

d) Solve the homogenous system by Gauss elimination  $3x+5y+4z = 0$ ,  $-3x-2y+4z=0$  and  $6x+y-8z=0$  (5 marks)

Find the determinant of the matrix D given  $D = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 1 & 0 \\ 2 & 1 & 2 \end{pmatrix}$  along column 2 (3 marks)