



# **MURANG'A UNIVERSITY OF TECHNOLOGY**

## **SCHOOL OF PURE AND APPLIED SCIENCES**

**DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY ORDINARY EXAMINATION**

**2018/2019 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR, BACHELOR OF  
SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING**

**AMM 122 – MATHEMATICS 11**

**DURATION: 2 HOURS**

**DATE: 25/4/2019**

**TIME: 9-11AM**

**Instructions to candidates:**

1. Answer question One 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 (30 MARKS)**

a) State giving reasons whether the following equations are linear or non-linear equations

i)  $2x_1 + \frac{1}{x_2} = 3$  2marks

ii)  $\cos 2x - \sin 2y = 1$  2marks

b) Differentiate between consistent and inconsistent system of linear equations 2marks

c) Solve the following system below by Gaussian elimination method 5marks

$$x_1 - 2x_2 + 3x_3 = 9$$

$$-x_1 + 3x_2 = -4$$

$$2x_1 - 5x_2 + 5x_3 = 17$$

d) Find the Taylor series generated by  $f(x) = 1/x$  at  $a = 2$ . where, if anywhere, does the series converge to  $1/x$ ? 5marks

e) Find the sums of the series  $\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$  State whether it converges or diverges 5marks

f) Determine the inverse of the matrix below by co-factor method  $M = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{pmatrix}$  5marks

g) Find the invariant points of the transformation defined by:  $x^1 = 1 - 2y$  4marks

$$y^1 = 2x - 3$$

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

**QUESTION TWO (20 MARKS)**

a) Find the inverse of matrix A below by Gauss-Jordan elimination  $A = \begin{bmatrix} 1 & 1 & 1 \\ 3 & 5 & 4 \\ 3 & 6 & 5 \end{bmatrix}$

Hence solve the system

$$x+y+z = 1$$

$$3x+5y+4z = 0$$

$$3x+6y+5z = 2$$

8marks

b) Find the sums of the following series:  $\sum_{n=1}^{\infty} \frac{3^{n-1}-1}{6^{n-1}}$

5marks

c) Solve the system below by Gaussian elimination with back substitution

$$\frac{2}{x} + \frac{1}{y} - \frac{3}{z} = 4$$

$$\frac{2}{x} + \frac{1}{z} = 5$$

$$\frac{-2}{x} + \frac{3}{y} - \frac{7}{z} = -9$$

7marks

**QUESTION THREE (20 MARKS)**

a) Find all the eigen values and the corresponding eigen vectors for the matrix

$$M = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$$

8marks

b) Determine the co-ordinate of the invariant point of the transformation given algebraically by:

$$x^1 = 2x + y - 1, \quad y^1 = -9x + 8y - 3$$

3marks

c) Solve the system equations

$$4x_1 + x_2 + x_3 = 2$$

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

$$x_1 + 2x_2 + 3x_3 = -4$$

Using the Jacobi-Iteration method. Take the initial approximation as  $x^{(0)} = \begin{pmatrix} 0.5 \\ -0.5 \\ -0.5 \end{pmatrix}$

Perform 3 iterations

9marks

#### QUESTION FOUR (20 MARKS)

a) Solve the system below using Gauss-Seidel method. Perform 3 iterations.

$$2x - y = 7$$

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

$$-y + 2z = 1$$

Take the initial approximation as  $x^{(0)} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$

10marks

b) Find the Taylor series and Taylor polynomials generated by  $f(x) = \cos x$  at  $x = 0$  6marks

c) Does the sequence whose  $n^{\text{th}}$  term is  $a_n = \left(\frac{n+1}{n-1}\right)^n$  converge? If so, find the  $\lim_{n \rightarrow \infty} a_n$

4marks