# MAASAI MARA UNIVERSITY

## REGULAR UNIVERSITY EXAMINATIONS

## 2023/2024 ACADEMIC YEAR

## SCHOOL OF PURE APPLIED AND HEALTH SCIENCES

## THIRD YEAR SECOND SEMESTER EXAMINATIONS

## FOR

## THE DEGREE OF BACHELOR OF SCIENCE MATHEMATICS AND BACHELOR OF EDUCATION

# MAT 3226-1: NUMERICAL ANALYSIS II

**DATE:** **TIME:**

**Duration: 2 Hours**

**INSTRUCTIONS**

1. This paper contains **FOUR** (4) questions in two sections A and B.
2. Section A is compulsory
3. Answer question **ONE (1)** in section A and any **Two** (2) questions from section B.
4. Do not forget to write your Registration Number.

## SECTION A

### QUESTION ONE

a) Use Gaussian elimination with pivoting to solve the equations

$$0.333x + 6.35y + 0.222z = 6.444$$
$$1.545x + 1.727y + 2.636z = 5.454$$
$$1.857x + 1.286y + 2.143z = 3.715$$

Make all the computations to 4dp **(6 Marks)**

b) Verify that $\begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ -2 & 3 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 & -1 \\ 0 & 1 & -1 \\ 0 & 0 & 2 \end{bmatrix}$ is a LU decomposition of a matrix A. Use the decomposition to solve the equation

$$\mathbf{A}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$ **(5 Marks)**

c) Find the Taylor series solution of the differential equation

$$\frac{dy}{dx} = x^2 - y \qquad y(1) = 2$$

upto the term $x^5$. Hence compute $y(1.1)$ to 4d.p **(5 Marks)**

d) Find the least square line that best fit the data

| $x_i$ | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| $y_i$ | -4 | -1 | 2 | 5 | 8 |

**(4 Marks)**

## SECTION B

### QUESTION TWO

Use Gauss – Seidel iterative method to solve the equation. **(15 marks)**

$$x_1 + 2x_2 + 3x_3 - x_4 = 34$$
$$2x_1 + 15x_2 + x_3 - 3x_4 = 25$$
$$10x_1 + x_2 + x_3 + 2x_4 = 16$$
$$4x_1 + x_2 + 20x_3 + x_4 = 68$$

Using $x_1^{(0)} = x_2^{(0)} = x_3^{(0)} = x_4^{(0)} = 0$. Perform your computations to 4d.p.

**QUESTION THREE**

Using $\mathbf{X}^{(0)} = [1 \quad 0 \quad 0]^T$ use the power method to get the dominant eigenvalue of the matrix

$A = \begin{bmatrix} 1 & 5 & -8 \\ 5 & -2 & 5 \\ -8 & 5 & 1 \end{bmatrix}$ to the nearest whole numbers and the corresponding Eigen vector with components whole numbers. Verify that $[1 \quad 0 \quad -1]^T$ is also an Eigen vector and state the corresponding Eigen value. Use an algebraic method to get the third Eigen value and the corresponding Eigen vector.

**(15 marks)**

**QUESTION FOUR**

Use the fourth order Runge – Kutta with 4 steps to find $y(1)$ given

$\frac{dy}{dx} + 2y = 4x$ , $y(0) = 1$ to four decimal places. **(15 marks)**