MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

(MMUST)

(MAIN CAMPUS)

UNIVERSITY MAIN EXAMINATIONS

2023/2024 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN MIE, CSE, SRT, BTB AND ECE

COURSE CODE: MAT 202 E/ MAT 262

COURSE TITLE: ENGINEERING MATHEMATICS II

DATE: 18TH April, 2024 **TIME:** 11:30AM - 2:30PM

INSTRUCTION

- Answer question **ONE** and **ANY OTHER TWO** questions.

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QUESTION ONE- COMPULSORY (30 Marks)

a. Estimate the value of $f(2)$ using the first 4 terms of the taylor series expansion of $f(x) = e^x$ around the point $a = 0$. Find the absolute error associated with the exact and estimate value of $f(2)$ **(5marks)**

b. Evaluate $(\Delta - \nabla)^2(x^2 + x + 1)$ given that the interval of differencing $h = 2$**(5 marks)**

c. Find the binary form of $(17.859375)_{10}$ **(4 marks)**

d. Find the sixth term of the sequence below using the forward difference table
8,12,19,29,42 **(4 marks)**

e. Solve the system below by Cramer's method **(5 Marks)**

$$x + 2y + z = 3$$
$$2x + 3y + 3z = 10$$
$$3x - y + 2z = 13$$

f. Find the approximate root of $2x^3 - 2x - 5 = 0$ using the fixed point iteration method. Use 4dp setting $x_0 = 1.5$ up tox_6 **(5 Marks)**

g. Describe any two types of errors encountered in computation **(2 Marks)**

Attempt ANY TWO Questions

QUESTION TWO (20 Marks)

a. Solve the system below by Crout's decomposition method **(7 Marks)**

$$x + y + z = 1$$
$$4x + 3y - z = 6$$
$$3x + 5y + 3z = 4$$

b. Find the Lagrange interpolation polynomial to fit the following data **(6 Marks)**

x	0	1	2	3
$e^x - 1$	0	1.7183	6.3891	19.0855

Hence evaluate the value of $e^{1.5}$

c. Find a straight line to the data given below by the method of least squares approximation. Use it to estimate the value of y at x=2.5 **(5 Marks)**

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

d. Prove that $E = 1 + \Delta$ **(2 Marks)**

QUESTION THREE (20 Marks)

a. Consider the system of equations below

$$4x - y + z = 7$$
$$4x - 8y + z = -21$$
$$-2x + y + 5z = 15$$

Apply 6 times the Gauss Jacobi scheme to obtain the approximate solution to the system above. Taking $(x_0 = 1, y_0 = 1, z_0 = 2)$ **(7 Marks)**

b. Find the real root of the equation $-4x + \cos x + 2 = 0$ by Newton Raphson Method up to 4d.p. Take $x_0 = 0.5$. **(7 Marks)**

c. Solve the system below using Gauss's elimination method **(6 Marks)**

$$16x - 4y + 4z = 24$$
$$-4x + 5y + 3z = -6$$
$$4x + 3y + 14z = 15$$

QUESTION FOUR (20 Marks)

a. Find the cubic polynomial in $x$which takes on the values $-3,3,11,27,57$ *and* 107, when $x = 0,1,2,3,4$ *and* 5 respectively. ***(7 Marks)***

b. Using linear interpolation formula, find the equation for the coordinates (6, 8) and (10, 16). What is the value of y when x=5? **(3 Marks)**

c. Use backward differences to find y_{-1} if $y_0 = 2, y_1 = 9, y_2 = 28, y_3 = 65, y_4 = 126$ and $y_5 = 217$ **(4 marks)**

d. Use Romberg's method to evaluate $\int_0^1 \frac{1}{1+x^2}\,dx$. Let $h_1 = 0.25$ and $h_2 = 0.125$ **(6 Marks)**

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QUESTION FIVE (20 Marks)

a. Find the first two derivatives of $x^{\frac{1}{3}}$ at $x = 50$ and $x = 57$ given the table below **(8 Marks)**

x	50	51	52	53	54	55	56
$y = x^{\frac{1}{3}}$	3.6840	3.7084	3.7325	3.7563	3.7798	3.803	3.8259

b. Evaluate $\int_0^{\pi} \sin x \, dx$ using the trapezoidal rule with 10 intervals. **(6 Marks)**

c. Evaluate $\int_0^{\pi} \sin x dx$ by the Simpson's rule. Compare your result with analytical result **(6 Marks)**

10 intervals

$$y = \Delta y_0 - \frac{1}{2}\Delta^2 y_0 + \frac{1}{3}\Delta^3 y_0 - \frac{1}{4}\Delta$$

$$\frac{1}{h}\left(\Delta y_n + \frac{2v+1}{2}\Delta^2 y_{-1} \frac{3v^2+6v+2}{6}\Delta^3 y_0\right.$$

$$\frac{1}{h}\left(\Delta^2 y_0 + v+1\,\Delta^3 y_0\right.$$

$\frac{\pi}{10} \times 10$

$\frac{2\pi}{10}$