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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2022/2023 ACADEMIC YEAR
THIRD YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE
(MATHEMATICS AND COMPUTER SCIENCE)

Date: 20th April, 2022
Time: 11.30am – 1.00pm

KMA 301 - NUMERICAL ANALYSIS 1

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) Construct an algorithm making use of the Newton Raphson method to find the square root of a positive number N. Hence find $\sqrt{12}$ correct to three decimal places. (3 Marks)
- b) Prove the following results:
- (i) $\Delta = \frac{\delta^2}{2} + \delta \sqrt{1 + \frac{\delta^2}{4}}$ (3 Marks)
- (ii) $\mu\sigma = \frac{\Delta E^{-1}}{2} + \frac{\Delta}{2}$ (3 Marks)
- c) Use false position method to find the smallest positive root to the equation $x^3 + 2x - 4 = 0$ correct to 4 decimal places. (3 Marks)
- d) Given the following data, evaluate $f(4)$ using Lagrange's interpolating polynomial

x	-1	0	2	3
f(x)	-8	3	1	12

(4 Marks)

- e) Find the solution to the following systems of equations using row reduction method.

$$\begin{aligned}4x - y - z &= 3 \\ -2x + 6y + z &= 9 \\ -x + y + 7z &= -6\end{aligned}$$

(3 Marks)

- f) Find the first and derivative of $f(x)$ at $x=1.5$ if

x	1	1.2	1.4	1.6	1.8	2
f(x)	0	0.128	0.544	1.296	2.432	4

(3 Marks)

- g) The sales for company A for the last five years are given in the table below. Estimate the sales for the year 1979.

Year	1974	1976	1978	1980	1982
Sales (in \$)	40	43	48	52	57

(4 Marks)

h)	x	1.5	2.0	2.5	3.0	3.5	4.0
	f(x)	3.375	7	13.625	24	38.875	59

Use trapezoidal rule to evaluate $\int_1^2 \frac{1}{x^2} dx$ when $n = 5$. (4 marks)

QUESTION TWO (20 MARKS)

- a) Find the Newton-Gregory backward difference interpolating polynomial for the following data:

x	1.0	1.2	1.4	1.6	1.8	2.0
f(x)	0	0.128	0.544	1.296	2.432	4

(8 marks)

- b) Find the solution to the following systems of equations using Gauss Seidel method up to the fourth iteration.

$$\begin{aligned} 4x - y - z &= 3 \\ -2x + 6y + z &= 9 \\ -x + y + 7z &= -6 \end{aligned}$$

(12 marks)

QUESTION THREE (20 MARKS)

- a) Evaluate $f(3.2)$ given the following table of values:

(7 Marks)

- b) For what values of x, y is maximum from the following data:

x	-1	0	1	2
f(x)	5	1	1	11

(8 Marks)

Use false position method to find the smallest positive root to the equation $x^2 - 2x - 1 = 0$ correct to four decimal places.

(5 Marks)

QUESTION FOUR (20 MARKS)

- a) A rod is rotating in a plane. The following table gives the angle θ (in radians) through which the rod has turned for various values of t (seconds). Calculate the angular velocity of the rod at $t=0.7$ seconds.

t	0	0.2	0.4	0.6	0.8	1.0
θ	0	0.12	0.49	1.12	2.02	3.20

(8 Marks)

- b) Find and correct a single error in y in the following table

X	0	1	2	3	4	5	6	7
f(x)	0	0	1	6	24	60	120	210

(6 Marks)

- c) A missile is launched from the ground station. The acceleration during the first 80 seconds of flight is recorded as given below.

t(s)	0	10	20	30	40	50	60	70	80
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a(m/s ²)	30	33.63	34.34	35.47	37.75	39.33	43.25	46.69	51.67
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Compute the velocity of the missile using Simpson's $\frac{1}{3}$ - rule.

(6 Marks)

QUESTION FIVE (20 MARKS)

- a) Express in the form LU the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 2 & -1 & 3 \\ 3 & 1 & -1 \end{bmatrix}$ where L is lower triangular with unit elements on its

diagonal and U is upper triangular. Use this to solve the simultaneous equations

$$\begin{aligned} x + y + z &= 3 \\ 2x - y + 3z &= 16 \\ 3x + y - z &= -3 \end{aligned}$$

(12 Marks)

- b) i) Write down the Lagrange polynomial which fits the points (3, 168), (7, 120), (9, 72), (10, 63).

(6 Marks)

- ii) Use it to interpolate the values of y at x = 8.

(2 Marks)