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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS, 2024/2025 ACADEMIC YEAR
THIRD YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE (COMPUTER SCIENCE)

KMA 2301: NUMERICAL ANALYSIS I

DATE: 6TH DECEMBER 2024
TIME: 11:30AM-1:30PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE: COMPULSORY (30 MARKS)

- a) Use Gauss Chebyshev 3-point formula to evaluate $\int_{-1}^1 (1-x^2)^{\frac{3}{2}} \cos x \, dx$ correct to 5 decimal places. **(4 Marks)**
- b) Find the cubic polynomial which takes the following values using Newton's forward interpolation formula **(5 Marks)**

x	0	1	2	3
f(x)	1	2	1	10

- c) Use method of synthetic division to obtain the quotient and the remainder when the polynomial $3x^5 + 5x^4 + 8x^2 + 7x + 4$ is divided by $(x+2)$ **(2 Marks)**
- d) Find the appropriate value of $I = \int_0^1 \frac{1}{1+x} \, dx$ using trapezoidal rule by taking $n=5$. Obtain the bound for truncation error. **(5 Marks)**
- e) Find an efficient method for computing square roots based on the Newton's method. Hence compute $\sqrt{17}$ correct to six decimal places. Perform only 3 iterations. **(5 Marks)**
- f) Determine the appropriate root of the equation $x - 2 \sin x = 0$ taking $x_0 = 2$ and using Aitken's δ^2 -process to 2 d.p. **(5 Marks)**
- g) Evaluate $x^4 - 8x^3 + 5x^2 + 7x - 7$ at $x = 2 + i3$ **(4 Marks)**

QUESTION TWO: (20 MARKS)

- a) Using quadratic Lagrange interpolation and given that $y(0) = 15$, $y(1) = 48$, $y(5) = 85$. Find
- The Lagrange interpolating polynomial $P_2(x)$ **(5 Marks)**
 - Value of y at $x = 2$ **(2 Marks)**
- b) Evaluate $\int_4^{5.2} \log e^x \, dx$ given that $h = 0.2$ using
- Trapezoidal rule **(3 Marks)**

- ii. Simpson rule (3 Marks)
- iii. Simpson $\frac{3}{8}$ rule (3 Marks)
- c) Use synthetic division to obtain quotient and remainder if $(4x^4 + 5x^3 + 3x^2 + 6x - 9) \div (2x^2 + 4x - 6)$ (4 Marks)

QUESTION THREE: (20 MARKS)

- a) Estimate $\int_0^1 \frac{1}{1+x} dx$ correct to 6 decimal places using Gauss Legendre
- i. 2-point formula (4 Marks)
- ii. 3-point formula (4 Marks)
- b) Using Bisection method to approximate the root of $f(x) = x^3 + x^2 - 3x - 3$
- i. Show that $f(x)$ has a root between 1 and 2 (2 Marks)
- ii. Determine the minimum number of iterations which can be performed for the root of the equation $f(x) = 0$ accurate to 2 decimal places. (4 Marks)
- iii. Find the approximate root correct to 2 decimal places. (6 Marks)

QUESTION FOUR: (20 MARKS)

- a) From the table below, estimate the number of students who obtained marks between 40 and 45 using Newton's forward interpolation formula (6 Marks)

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

- b) Given that $f(x) = 2x^3 - 7x + 2$ and using the iterative formula $x_{n+1} = \frac{2}{7}(x_n^3 + 1)$
- i. Show that $f(x)$ has a root between 0 and 1 (2 Marks)
- ii. Determine if the iterative x_{n+1} converges. (3 Marks)
- iii. Hence find the root of $f(x)$ correct to 3 decimal places. (5 Marks)
- c) Estimate $\int_1^{1.3} \sqrt{x} dx$ to 4 decimal places using Simpson's $\frac{1}{3}$ rule and when $h = 0.15$ (4 Marks)

QUESTION FIVE: (20 MARKS)

- a) Use Newton's iterative with synthetic division to find a zero of the polynomial $f(x) = x^4 - 4x^3 + 7x^2 - 5x - 2$ starting with $x_0 = 0$ correct to 4 decimal places. Perform 5 iterations. (6 Marks)
- b) In determining the approximations to the positive roots of the equation $2x^3 - 7x + 2 = 0$ using the rule of false position in 3 decimal places
- i. Investigate the convergence of the iterative. (4 Marks)
- ii. Hence perform 4 iterates to approximate the root (5 Marks)
- c) Using the data below, find Newton's interpolating polynomial (5 Marks)

x	0	10	20	30	40
y	7	18	32	51	87