UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

SEMESTER 1 EXAMINATIONS

THIRD YEAR EXAMINATION FOR BSc GENERAL

MTC3101 NUMENRICAL ANALYSIS I

Date: January 20, 2022

Time: 9:30 AM – 12:30 PM

INSTRUCTIONS

1. Carefully read through **ALL** the questions before attempting
2. Attempt any **FIVE** of the seven questions
3. Ensure that your **Reg number** is indicated on all pages of the examination answer booklet
4. Ensure your work is **clear** and **readable**. Untidy work shall be penalized
5. Any type of examination malpractice will lead to automatic disqualification
6. Calculators and mathematical tables may be used

1. (a) [**10 marks**] Using four-digit chopping and rounding arithmetic, perform the following calculation $\frac{\frac{13}{14}-\frac{6}{7}}{2e-5.4}$. With the exact value determined to at least five digits, compute the absolute error and relative error.

   (b) [**10 marks**] Use the Bisection method to find a solution accurate to within 10^{-3} for $x^3 - 7x^2 + 14x - 6 = 0$ on $[1, 3.2]$

2. (a) [**10 marks**] Use the fixed-point iteration method to find a solution accurate to within 10^{-2} for $x^4 - 3x^2 - 3 = 0$ on [1, 2] using an appropriate iteration function g.

(b) [**10 marks**] Use Newton-Raphson method to find a solution accurate to within 10^{-5} for $x^3 + 3x^2 - 1 = 0$ on [-3, -2].

3. (a) [**10 marks**] Use Secant method to find a solution accurate to within 10^{-5} for $\ln(x-1) + \cos(x-1) = 0$ for $1.3 \le x \le 2$.

(b) [**10 marks**] [10 marks] Use the method of False Position to find solution accurate to within 10^{-5} for $e^x + 2^{-x} + 2\cos x - 6 = 0$ for $1 \le x \le 2$.

4. (a) [**10 marks**] Use appropriate Lagrange interpolating polynomial of degree three to approximate f(0.25) if f(0.1) =0.62049958, f(0.2) = -0.28398668, f(0.3) = 0.00660095, f(0.4) = 0.24842440.

(b) [**10 marks**] Use Newton's interpolating divided-difference formula to construct interpolating polynomial of degree three and use it to approximate f(-1/3) if f(-0.75) = -0.07181250, f(-0.5) = -0.02475000, f(-0.25) = 0.33493750, f(0) = 1.10100000

5. (a) [**10 marks**] Use Newton's forward-difference formula to construct interpolating polynomial of degree three and use it to approximate f(0.18) if f(0.1) = -0.29009986, f(0.2) = -0.56079734, f(0.3) = -0.81401972, f(0.4) = -1.0526302.

(b) [**10 marks**] Use Newton's backward-difference formula to construct interpolating polynomial of degree three and use it to approximate f(0.43) if f(0) = 1, f(0.25) = 1.648722, f(0.5) = 2.71828, f(0.75) = 4.48169.

6. (a) [**10 marks**] Consider the following table of data:

x	0.2	0.4	0.6	0.8	1.0
f(x)	0.9798652	0.9177710	0.808038	0.6386093	0.3843735

Use Three-Point Endpoint and Midpoint formulas as well as the Second Derivatives Midpoint formula to approximate

(i) $f'(0.4)$ and $f''(0.4)$

(ii) $f'(0.6)$ and $f''(0.6)$

(b) [**10 marks**] Approximate the integral $\int_1^{1.6} \frac{2x}{x^2-4} dx$ using the Trapezoidal rule.

Calculate the actual error.

7. (a) [**10 marks**] Approximate the integral $\int_1^{1.5} x^2 \ln x dx$ using the Simpson's rule.

Calculate the actual error.

(b) [**10 marks**] Approximate the integral $\int_0^{1.} x^2 e^{-x} .dx$ using the Midpoint rule with n = 3.

Calculate the actual error.