Adama Science and Technology University
College of Applied Natural Sciences
Department of Applied Mathematics
Numerical Analysis (Math3201) Mid-Examination

Date: March31, 2024 G.C
Time Allowed: 1:45 hrs.
Max. Marks: 20%

Name: _____

ID No: _____

Department and Group: _____

Add ☐ **(If you add this course, sign here)**

GENERAL DIRECTIONS:

- ✓ ***Make Shure that this booklet contains of FIVE multiple choices, SIX short answer questions and TWO workout problems.***
- ✓ ***Using mobile phone is strictly FORBIDDEN in the examination.***
- ✓ ***Don't use pencil for writing your answer.***
- ✓ ***Check there are 4 pages including the cover page.***
- ✓ ***Any attempt of cheating during exam will result in 0 marks.***

For instructor's use only

Examination part	I (5%)	II (5%)	III (10%)	Total (20%)
Marks				

Do Not Turn This Page Until You Are Told To Do So!

Part I (Multiple choices): Choose the best answer and circle it (Each worth 1 point)

1. Round-off error occurs due to:

A. Using an approximation instead of an exact mathematical model

B. Limited precision in floating-point arithmetic

C. Errors in input data measurement

D. Accumulation of errors in iterative calculations

2. Which of the following numbers cannot be exactly represented in a standard floating-point system?

A. 0.5 B. 0.25 C. 0.1 D. 1.0

3. Why is machine epsilon important in numerical computations?

A. It determines the rounding error in floating-point arithmetic.

B. It defines the maximum value a floating-point number can store.

C. It prevents underflow and overflow errors.

D. All of the above

4. What does error propagation refer to in numerical computations?

A. The accumulation of rounding errors in a sequence of arithmetic operations.

B. The inability to represent small numbers due to floating-point limitations.

C. The process of systematically reducing numerical errors in computation.

D. The random occurrence of errors in computational systems.

5. For a method with $|e_{n+1}| \approx C|e_n|^P$ if $P = 1$ and $C = 0.5$, how many iterations are needed to reduce the error by 10^{-6}?

A. 6 B. 20 C. 50 D. 100

Part II (Short Answer): Write the most simplified answer on the space provided (Each worth 1 pt.)

6. Encode the floating point number -39.9 using the IEEE standard format. Assume your computer has a single precision. **Answer**:_____

7. The percentage error in the time period $T = 2\pi\sqrt{\frac{\ell}{g}}$ for $\ell = 1m$ if the error in the measurement of ℓ is 0.01. **Answer:**_____

8. Find the minimum number of iteration required for the Bisection Method to obtain the root of an equation $f(x) = 0$ on [4, 5] with a tolerance of $\varepsilon = 10^{-3}$. **Answer:**_____

9. Using Newton-Raphson method, determine the root of the equation $x^4 - x - 10 = 0$ correct to three decimal places by taking $x_0 = 1.5$. **Answer:**_____

10. Determine the root of the equation $x^2 = 6$ with absolute error tolerance $\varepsilon = 10^{-1}$, using Secant method. Take $x_0 = 3, and\ x_1 = 2$. **Answer:**_____

PART III (Work-Out Items): Work out the following questions by showing all the necessary steps clearly.

11. Let $\boldsymbol{x = \pi}$ $\boldsymbol{and}$ $\boldsymbol{\bar{x} = 3.141592653}$ where $\bar{x}$ is the approximate value of x. Then

a) Calculate the absolute error and relative error in the approximation. **(2 points)**

b) Determine the number of correct significant figures in $\bar{x}$. **(1 points)**

c) Estimate the total absolute error and relative error in calculating the area of a circle, $A = \pi r^2$, with $r = 10.0 \pm 0.1\ cm$ due to the errors in both π and r. Which (the uncertainty in $\boldsymbol{r}$ or $\boldsymbol{\pi}$) is the dominant error source in A? **(3 points)**

12. Find where the graphs of $y = 3x - 1$ and $y = cosx$ on $[0, \frac{\pi}{2}]$ intersect correct to three decimal places, using fixed point iteration method. (Take $x_0 = 0$) **(4 points)**