



THE UNIVERSITY OF ZAMBIA
School of Natural Sciences
Department of Computer Science

FINAL EXAMINATION

CSC 2912
NUMERICAL ANALYSIS

Date : 19 NOVEMBER 2018
Time : 14:00hrs – 17:00HRS
Duration : 3 Hours
Venue : NSLT

Instructions

1. There are **two (2)** Sections in this exam, **Section A** and **Section B**.
2. In Section A, answer all the questions and in Section B **choose any three (3) questions**.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

1. Let $f: R \rightarrow R$ be a function defined on R . Define the following: [12 Marks]
 - a. Limit L of a f at x_0
 - b. Continuity of a f at x_0
 - c. Differentiability of a function at x_0
2. Suppose a number p_0 approximates p . Define the following [4 Marks]
 - a. Absolute error of this approximation
 - b. Relative error of this approximation
3. State the following theorems [18 Marks]
 - a. Rolle's theorem
 - b. Mean value theorem
 - c. Intermediate value theorem
 - d. Taylor's theorem
4. Suppose p_0 approximates 100 to 5 significant digits. What is the range of p_0 ? [4 Marks]
5. Let a function f have a root in $[2, 3]$. How many iterations of the bisection method are required to approximate the root to 10^{-4} accuracy? [4 Marks]

SECTION B: ANSWER THREE (3) OF THE FOUR (4) QUESTIONS

1.
 - a. Prove that if a function f is differentiable at a point x_0 , then it is also continuous at x_0 . [10 Marks]
 - b. Use the mean value theorem to show that for an interval $[a, b]$, where $a > 0$, and $\left|\frac{1}{x}\right| \leq K, \forall x \in [a, b]$. [10 Marks]

$$\ln\left(\frac{b}{a}\right) \leq K|b - a|$$

2.
 - a. How many iterations are required to approximate $\sqrt{2}$ in $[1, 2]$ to 10^{-4} accuracy using the Bisection method? [10 Marks]
 - b. Use the Newton's method to approximate $\sqrt{2}$ to 10^{-4} accuracy. Let $p_0 = 1$ [10 Marks]

3.

- a. Suppose $x_0 = 1$, $x_1 = 2$, and $x_2 = 3$, and you are given that $P_{0,1}(x) = 2x$ and $P_{0,2}(x) = x^2$, find $P_{0,1,2}(2.5)$ [10 Marks]

- b. Given the following data

x	1	2	3
y	1.6	4.4	12

Use the Newton's divided difference method to interpolate $f(1.5)$ [10 Marks]

4.

- a. Estimate [8 Marks]

- $f'(3)$
- $f''(2)$

- b. Estimate

$$\int_2^4 x^2 dx$$

using the composite [12 Marks]

- Trapezoidal rule, with $h = 1$
- Simpson rule, with $n = 2$

*****END OF EXAMINATION*****