King Saud University
Department of Mathematics
Second Semester 1436-1437 H

MATH 352 (Numerical Analysis)
Second Midterm Exam
Duration: $1\frac{1}{2}$ Hours

Student's Name	Student's ID	Group No.

Question No.	I	II	III	IV	V	Total
Mark						

[**I**] Determine whether the following is **True** or **False**. **Justify** your answer. [4 *Points*]

1. The Newton Method **converges quadratically** to the root $p = 0$ of the function $f(x) = e^{2x} - 2x - 1$. ( )

2. The sequence $p_n = \frac{1}{n^2}$, $n \geq 1$ **converges linearly** to zero. ( )

3. If $x_0 = 2$ and $x_1 = 2.75$ are used to find the first Lagrange interpolation polynomial for $f(x) = \frac{1}{x}$, **then the error is less than** 0.04. ( )

OVER

[II] Let $f(x) = x^5 + x + 1$. [3 *Points*]

(a) **Use** three iterations of the Newton Method to **approximate** the root of f on $[-1, 1]$.

(b) **How accurate** is the approximation in (a)? **Justify** your answer.

OVER

[III] Let $f(x) = x^3 - x - 3$. For $p_0 = 1.5$ and $p_1 = 2$, [4 *Points*]

(a) **Find** p_2 using the Secant Method.

(b) **Find** p_4 using the method of False Position.

OVER

[IV] Use the second Lagrange interpolation polynomial with three distinct nodes x_0, $x_1 = x_0 + h$ and $x_2 = x_0 + 2h$ to **derive** the formula

$$f'(x_0) \approx \frac{1}{2h}\left[f(x_0 + h) - f(x_0 - h)\right] \qquad [4 Points]$$

OVER

[V] Use the data in the following table for all parts of this question. [5 *Points*]

x	0.1	0.4	0.7	1.0
f(x)	0.1103	0.5809	1.297	2.287

(i) **Approximate** $f(0.5)$ by the Newton Forward-Difference formula with 3 points.

(ii) **Approximate** $f''(0.7)$ by a second derivative midpoint formula.

Good Luck