King Saud University		**MATH 352 (Numerical Analysis 1)**
Department of Mathematics		**Second Midterm Exam**
Second Semester 1438-1439 H		**Duration: 2 Hours**

Student Name	**Student ID**	**Group Number**

Question Number	**I**	**II**	**III**	**IV**	**Total**
Mark					

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

1. The sequence $p_n = \frac{2}{n^3}$ converges **linearly** to zero ( )

2. $x = 0$ is a **simple root** of $f(x) = x^2 - xe^x$ ( )

3. **If** $f[x_1, x_2] = 4$, $f[x_1, x_2, x_3] = 9$ for $x_1 = 1$, $x_2 = 3$, $x_3 = 5$. **Then** $f[x_2, x_3] = 1.25$

( )

[II] [5 *Points*]

(A) **Use Newton's method** to find a solution accurate to within 10^{-2} for $x^3 - x^2 - 3 = 0$ on $[1,2]$

(B) Let $f(x) = x^2 - 7$. With $p_0 = 3$ and $p_1 = 2$, **find $\boldsymbol{p_3}$** using

1. The Secant method
2. The method of False-Position
3. Which method gives a better approximation for $\sqrt{7}$

[III] Let $f(0) = 1, f(0.3) = 1.546, f(0.6) = 1.954.$ [4 *Points*]

(a) Find the **second Lagrange** polynomial interpolating f

(b) If $f(x) = cosx + 2sinx$, use the error formula to find an **upper bound** for the error in (a)

[IV] Use the data in the following table for all parts of this question. [7 Points]

x	0.3	0.5	0.7	0.9
$f(x)$	0.7408	0.6065	0.4965	0.4065

(i) **Approximate** $f(0.4)$ by Newton's Divided Difference Formula using 3 nodes

(ii) **Approximate** $f'(0.7)$

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

(iv) If $\left|f^{(4)}(\xi)\right| \leq 0.8$ for$\xi \in (0.3,0.9)$, **find a bound** for the error of the approximation in (iii).

Good Luck ☺