FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL ENGINEERING

ENGR-391 NUMERICAL METHODS FOR ENGINEERS

Student's Name: _____

I.D.: _____

Duration 60 minutes

PROBLEM 1 [Taylor series] (20 points)

Consider the following function:

$$f(x) = \frac{1}{x^2}$$

1- Compute the analytical derivative of f(x) for x=2.
2- Compute numerically the derivative of f(x) for x=2, using the forward, backward and centered formulations using h=0.01 and then for h=0.05. What is the most accurate formulation and what is the effect of increasing h?

NOTE: Keep 5 significant digits for the results.

PROBLEM 2 [Newton-Raphson Method] (40 points)

Consider the following function:

$$f(x) = x^6 - x - 1$$

1- Explain graphically Newton-Raphson method.

2- Solve for f(x)=0 using Newton-Raphson Method in the interval **[1 2]**.
- Use as an initial guess **x=1.5**.
- Compute **five iterations**, and compute the **relative error for each iteration**.

NOTE: Keep 5 significant digits for the results.

PROBLEM 3 [LU Decompostion] **(40 points)**

Consider the following system of linear equations:

$$\begin{cases} 4x_1 - x_2 + x_3 = 6 \\ 8x_1 + 3x_2 - x_3 = 10 \\ 3x_1 + x_2 + x_3 = 9 \end{cases}$$

1- Write the system under the form: $[A]\{X\} = \{B\}$
2- Is the system ill-conditioned?
3- Solve the system using LU decomposition.
4- Replace your solution in the system.