Name: **Lab# 02** **Your ID #:**

Taylor Series

Please answer the below questions:

Q1 (2.*5pts*): Write a python code to for **Taylor Series and its estimated error.**

Q2 (*5pts*): Choose 2 functions to approximate (e.g. sin(x), cos(x), exp(x), log(x), etc.). For each one do the following:

- Study the function using the desmos graphing and write your observation.
- Select two points around which to expand the function (e.g. x=0, and x=1).
- Approximate the function around one of the two points write your observation.
- Use the derivative of the function at the selected point to find the coefficients of the Taylor polynomial.
- Plot the function and its Taylor approximation over a chosen range
- Vary the order of the Taylor expansion and observe the effect on the approximation.
- Compare the accuracy of the Taylor approximation.
- Discuss the limitations and applications of Taylor expansions in computational physics.

Q3 (*5pts*): Apply the **Q2** rules to your physics problem that you have choosing and discuss the solution.

Q4 (2.*5pts*): Evaluate **Maclaurin expansions** for <u>**one**</u> of the following function:

Five Basic Maclaurin Expansions

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 \cdots = \sum_{n=0}^{\infty} x^n$$

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} \cdots = \sum_{n=0}^{\infty} \frac{x^n}{n!}$$

$$sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{(2n+1)!}$$

$$cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!}$$

$$ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n x^{n+1}}{n+1}$$