DEPARTMENT OF MATHEMATICS
IIT GUWAHATI

MA 332 **Scientific Computing** **Lab - IV**

1. The following data represents the function $f(x) = \exp(x)$.

x	1.0	1.5	2.0	2.5
$f(x)$	2.7183	4.4817	7.3819	12.1825

   Estimate the value of $f(2.25)$ using the (i) Newton's forward difference interpolation and (ii) Newton's backward difference interpolation. Compare with the exact value.

2. Find the Newton's forward interpolating polynomial of degree 10 that interpolates the function $\arctan x$ at 11 equally spaced points in the interval $[1, 6]$. Print the coefficients in the Newton form of the polynomial. Compute and print the difference between the polynomial and the function at 33 equally spaced points in the interval $[0, 8]$.What conclusion can be drawn?

3. Construct the Lagrange interpolating polynomial for the function $f(x) = \ln x$, and find a bound for the absolute error on the interval $[x_0, x_3]$, where $x_0 = 1$, $x_1 = 1.1$, $x_2 = 1.3$, $x_3 = 1.4$.

4. Write programmes for constructing Langrange and Newton's divided difference interpolating polynomials for approximating a function at a given set of data points. Using them, find $f(0.2)$ from the following table:

x	0.0	0.1	0.3	0.6	1.0
$f(x)$	-6.00000	-5.89483	-5.65014	-5.17788	-4.28172

   Are you getting the same result from both the polynomials? If so, why?
   Add $f(1.1) = -3.99583$ and see how it effects your solution.

5. Use appropriate Lagrange interpolating polynomials to approximate each of the following:

   a) $f(0.18)$ if $f(0.1) = -0.29004986$, $f(0.2) = -0.56079734$, $f(0.3) = -0.81401972$, $f(0.4) = -1.0526302$

   b) $f(0.25)$ if $f(-1) = 0.86199480$, $f(-0.5) = 0.95802009$, $f(0) = 1.0986123$, $f(0.5) = 1.2943767$

6. A census of the population of the United States is taken every 10 years. The following table lists the population, in thousands of people, from 1950 to 2000:

Year	1950	1960	1970	1980	1990	2000
Populations (in thousands)	151,326	179,323	203,302	226,542	249,633	281,422

Use appropriate divided differences to approximate the population in the years 1940, 1975, 2020.

7. Consider a function $f(x)$ such that $f(2) = 1.5713$, $f(3) = 1.5719$, $f(5) = 1.5738$ and $f(6) = 1.5751$. Estimate $f(4)$ using a second-degree interpolating polynomial and third-degree polynomial. Round the final results off to four decimal places. Is there any advantage here in using a third-degree polynomial ?
