Experiment-10

Aim:- Plots of the logarithmic functions and comparison with the plots of their Taylor series expansion till first 10 terms

Code :

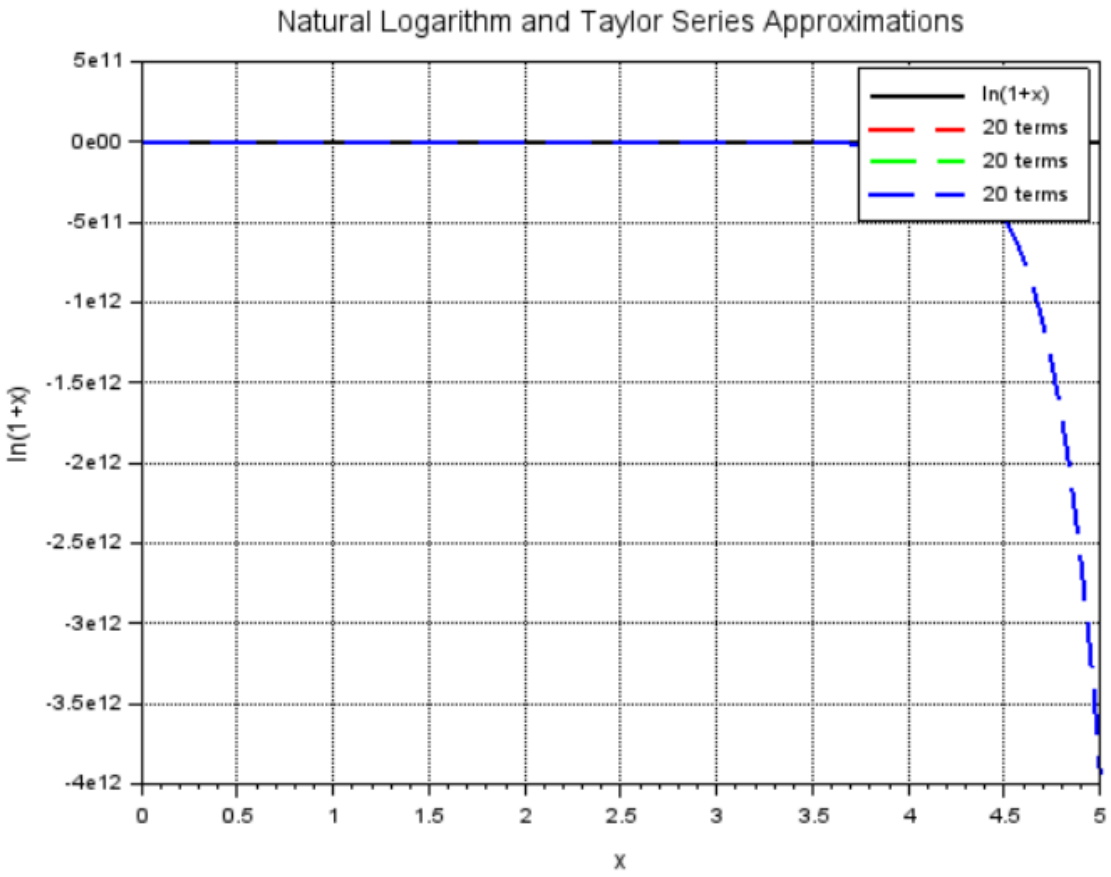
```
clc;clf;clear;

disp("Prattayaya amrit")

disp("13601")

disp("Plots of the logarithmic functions and comparison with the plots
of their Taylor series expansion till first 10 terms")

// Define the function to calculate the Taylor series expansion of
ln(1+x)

function sum=log_series(x, t)

    sum = 0;

    for i = 1:t

        sum = sum + ((x^i) / i) * (-1)^(i + 1);

    end

endfunction


// Get user inputs

disp("Enter the range of x for plotting:");

x_min = input("Minimum x (e.g., 0.1): ");

x_max = input("Maximum x (e.g., 2): ");

n_points = input("Number of points for plotting (e.g., 100): ");

disp("Enter the number of terms for Taylor series approximations:");

terms_2 = input("Number of terms for first approximation (e.g., 2):
");

terms_3 = input("Number of terms for second approximation (e.g., 3):
");

terms_8 = input("Number of terms for third approximation (e.g., 8):
");

disp("Enter specific x points for the table (comma-separated):");

x_points = input("e.g., [0.5, 1, 1.5, 2]: ");
```

```
// Generate x values for plotting
x = linspace(x_min, x_max, n_points);

// Compute true values and approximations
fx = log(1 + x); // True values of ln(1+x)
fx_2_terms = zeros(x); // Placeholder for 2 terms approximation
fx_3_terms = zeros(x); // Placeholder for 3 terms approximation
fx_8_terms = zeros(x); // Placeholder for 8 terms approximation

for i = 1:length(x)
    fx_2_terms(i) = log_series(x(i), terms_2);
    fx_3_terms(i) = log_series(x(i), terms_3);
    fx_8_terms(i) = log_series(x(i), terms_8);
end

// Plotting
clf(); // Clear the figure
plot(x, fx, '-k', 'LineWidth', 2); // True values of ln(1+x) in black
plot(x, fx_2_terms, '--r', 'LineWidth', 2); // 2 terms approximation
in red
plot(x, fx_3_terms, '--g', 'LineWidth', 2); // 3 terms approximation
in green
plot(x, fx_8_terms, '--b', 'LineWidth', 2); // 8 terms approximation
in blue

// Add legends and labels
legend(['ln(1+x)', sprintf('%d terms', terms_2), sprintf('%d terms',
terms_3), sprintf('%d terms', terms_8)], "location", "northwest");
xlabel('x');
ylabel('ln(1+x)');
title('Natural Logarithm and Taylor Series Approximations');
```

```
xgrid(); // Add gridlines


// Compute values for specific x points
fx_points = log(1 + x_points);                  // True values of
ln(1+x)
fx_2_points = zeros(x_points); // Placeholder for 2 terms
approximation
fx_3_points = zeros(x_points); // Placeholder for 3 terms
approximation
fx_8_points = zeros(x_points); // Placeholder for 8 terms
approximation


for i = 1:length(x_points)
    fx_2_points(i) = log_series(x_points(i), terms_2);
    fx_3_points(i) = log_series(x_points(i), terms_3);
    fx_8_points(i) = log_series(x_points(i), terms_8);
end


// Display the table
disp("Index | X       | ln(1+X)     | ln(1+X) upto 2 terms | ln(1+X)
upto 3 terms | ln(1+X) upto 8 terms");
disp("----------------------------------------------------------------
---------------");
for i = 1:length(x_points)
    mprintf("%5d | %8.4f | %10.4f | %20.4f | %20.4f | %20.4f\n", i,
x_points(i), fx_points(i), fx_2_points(i), fx_3_points(i),
fx_8_points(i));
end
```

OUTPUT

```
  "Prattayaya amrit"
  "13601"
  "Plots of the logarithmic functions and comparison with the plots of their Taylor series expansion till first 10 terms"
  "Enter the range of x for plotting:"
Minimum x (e.g., 0.1): 0.01

Maximum x (e.g., 2): 5

Number of points for plotting (e.g., 100): 1000

  "Enter the number of terms for Taylor series approximations:"
Number of terms for first approximation (e.g., 2): 20

Number of terms for second approximation (e.g., 3): 20

Number of terms for third approximation (e.g., 8): 20

  "Enter specific x points for the table (comma-separated):"
e.g., [0.5, 1, 1.5, 2]: [0.03,0.06,0.09,0.12,0.15,0.18]

  "Index | X       | ln(1+X)     | ln(1+X) upto 2 terms | ln(1+X) upto 3 terms | ln(1+X) upto 8 terms"
  "------------------------------------------------------------------------------"
    1 |   0.0300 |     0.0296 |               0.0296 |               0.0296 |               0.0296
    2 |   0.0600 |     0.0583 |               0.0583 |               0.0583 |               0.0583
    3 |   0.0900 |     0.0862 |               0.0862 |               0.0862 |               0.0862
    4 |   0.1200 |     0.1133 |               0.1133 |               0.1133 |               0.1133
    5 |   0.1500 |     0.1398 |               0.1398 |               0.1398 |               0.1398
    6 |   0.1800 |     0.1655 |               0.1655 |               0.1655 |               0.1655
exec: Wrong number of output argument(s): 0 expected.

-->
```


Natural Logarithm and Taylor Series Approximations
ln(1+x)
20 terms
20 terms
20 terms
5e11
0e00
-5e11
-1e12
-1.5e12
-2e12
-2.5e12
-3e12
-3.5e12
-4e12
ln(1+x)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
x