Experiment 6

Taylor Series

I. Aim

Using MatLab to find Taylor series expansion for error function which appears as a solution in several fluid flow and heat transfer problems.

II. Mathematical Background:

A Taylor's series expansion of a function is a series expansion of the function about a required or a given Point.

III. MATLAB Code for Taylor Series approximation (1st Order)

```
clc
clear all
syms x
f= input('Ënter the function f(x):');
a=input('Point about which function is to be expanded');
n=input('Enter the order of terms:');
range=input('Enter the range in the form of [x0 x1 y0 y1] for plotting:');
tayser = taylor(f,x,a,'Order',n+1);
ezplot(f,range);
hold on;
ezplot(tayser,range);
grid on;
title('Taylor series approximation ');
legend(char(f),'Taylor series approximation','Best');
```

IV. MATLAB Code for Taylor Series approximation (Non - 1st Order)

```
clc
clear all
syms x
f=input('Ënter the function f(x):');
a=input('Enter the point around which Taylor series is sought:');
range=input('Enter the range in the form of [x0 y0] for plotting:');
for i=1:5
    n=input('Enter the number of terms:');
    tayser = taylor(f,x,a,'Order',n+1)
    subplot(2,3,1);
    ezplot(f,range)
```

```
    hold on;
    ezplot(tayser,range);
    grid on;
    c=c-1;
    title('Taylor series approximation ');
    legend(char(f),'Taylor series approximation','Best');
end
```

V. MATLAB Code for stoke's theorem using Taylor Series

```
%stoke's theorem using taylor series
clc
clear all
syms x y
nu = input('Enter the value of nu: ');
t = input('Profile to be plotted at time:');
x = y/(2*sqrt(nu*t));
% erf is error function predefined and taking the constant velocity to be
% 1
extsol = 1 - erf(x);
f = exp(-(y^2));
f10 = taylor(f,y,0,'Order',10);  %10 term approx
f21 = taylor(f,y,0,'Order',21);  %21 term approx
sol10 = 1-(2/sqrt(pi))*int(f10,y,0,x); % Term by term integration of f10
sol21 = 1-(2/sqrt(pi))*int(f21,y,0,x);
range = [0 5 -0.1 1.1];
ezplot(extsol,range)
hold on
grid on
ezplot(sol10,range)
ezplot(sol21,range)
title('Taylor Series Approximation')
xlabel('x')
ylabel('u/U')
legend('Exact Solution','10 term approx.','21 term approx','Location','Best')
```

VI. Exercise Answer (By making appropriate changes in Code in Section V)

```
clc
clear all
syms x y
nu=input('Enter the value of nu: ');
t=input('Profile to be plotted at time: ');
y=x/(2*sqrt(nu*t));
extsol=1-erf(y);
f=exp(-x^2);
f10=taylor(f,x,0,'Order',10);
f20=taylor(f,x,0,'Order',21);
sol10=1-(2/sqrt(pi))*int(f10,x,0,y);
```

```
sol20=1-(2/sqrt(pi))*int(f20,x,0,y);
range=[0 30 -0.1 1.1];
ezplot(extsol,range);
hold on;
grid on;
ezplot(sol10,range);
ezplot(sol20,range);
ezplot(int(sol20,x,0,y),range);
ezplot(diff(sol20,x),range);
title('16BCE0783 - Stokes Theorem using Taylor Series Approximations');
legend('Exact Solution','10 term approx.','20 term approx.','Integral','Differential');
```