problem 5

What is Gibb's Phenomenon? Research this and come up with an example where you can both demonstrate Gibb's phenomenon as well as compute the error predicted by Gibb's phenomenon precisely for your example. (Show that your FS representation can never improve at points of discontinuity to be better than BLANK.)

Solve:

Gibb's Phenomenon is the phenomenon that the Fourier Series can not represent well at the jump point or corner of period function.

The example used here are the same as the last problem

$$f = \begin{cases} 0 & -3 \le x \le -1 \\ 1 & -1 \le x \le 1 \\ 0 & 1 \le x \le 3 \end{cases} \qquad (24)$$

The test are only focus on the interval [-1, 1].

From the last problem we know that, the error can be compute as:

$$e_m(x) = f(x) - s_m(x) \qquad (25)$$

Then we can test for different num of partial sum and compute the equation (25) and find the largest the result.

```
clear
num_n = 1000;%number of partial sum will be tested
```

```
num_n =
        1000
```

```
k = num_n;%number of interval
x = linspace(-1, 1, k);%define x

jx = zeros(1, num_n);
maxx = zeros(1, num_n);
%loop for each number of n then calculate the nth sum of Fourier Series
for j = 1:num_n
    jx(j) = j;
    maxx(j) = max(sm(j, x)) - 1;%compute the nth sum of Fourier Series.
    % Then compute the difference with 1
    %Then take the largest on
end
Mean_FS_error = mean(maxx)%roughly calculate the averge of all off the error
```

```
ans =
   0.083156516012034
```

Then if we plot them

```
plot(jx, maxx)
xlabel('n')
ylabel('error')
```

```
title('error from Fourier Series at the edge of the function vs the nth Fourier Series')
```

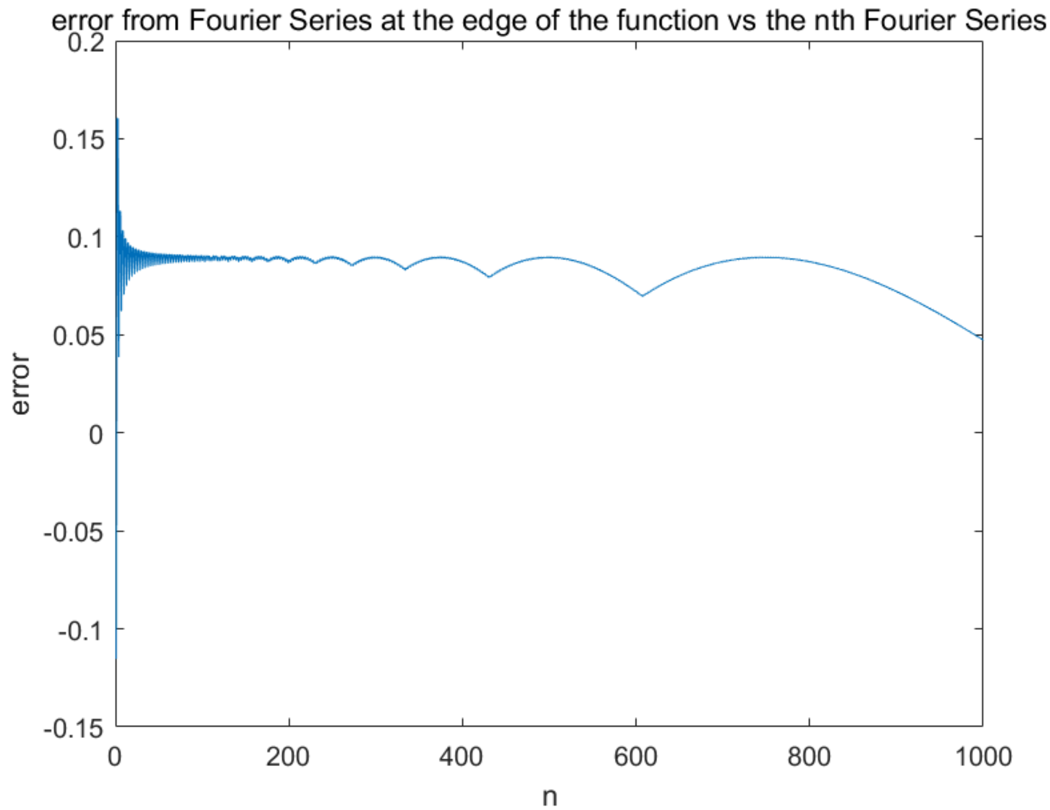

Fig 5.1 The plot of error with different n

From the graph we could see the difference between FS and true function are varbriating between 0.05 and 0.1. Also as much n we take the amplitude will increasing.

```
function [s] = sm(m, x)
%function of calculate partial sum from equation (21)
    s = 0;
    for j = 1:m
        s = s + an(j).*cos(j*pi.*x/3);
    end
    s = s + 1/3;
end

function [a] = an(n)
    a = 2/(n*pi)*sin(n*pi/3);
end
```