**Lab 1 - Fourier Series Analysis and Synthesis**

* 1. **Finding Fourier series coefficients:**

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From the plot , we get the a0 value as 1/16 which is same as that found by the analytic calculation.

**1.2 FS reconstruction and finite FS approximation error**

For a signal 𝑥(𝑡) with Fourier series coefficients {𝑎𝑘 }, a partial Fourier sum (of order N) is given as

**x(𝑡) =**

1. The maximum absolute error between original signal and reconstructed signal:

The maximum absolute error between original(yt) and reconstructed signal(y) is defined as the maximum of

Ei = | yt(i) – y(i) | for all values of i along the X-axis.

So, if we calculate the error manually for some values of i

| 0.0009-0.0003|,|0.0006-0.0001|,|0.0005-0.0002|

So, the maximum absolute error is approximately

0. 6 \* 10^-3

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1. The mean squared error between y and original signal and reconstructed signal:

The mean squared error is defined as the mean of squares of each Ei from above …

**Error = sum of all (Ei’s^2)/M** M: no of Ei’s;

But as the Ei’s are too small so the square mean error is much smaller and can be approximated to zero…

The error is visible only at 10^-7 values..

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**1.3 Gibbs Phenomenon – square wave:**

c. As N is increased the graph comes close to a square graph.

d. As the N increases the number of oscillations decreases and finally, we get a square wave.

**1.4 Fourier series – more examples and symmetry properties:**

C.

1. For x1(t):

As seen from the figure the function in the question 4a is the mod x function which is an even function hence its Fourier series coefficient will be real and even.

A picture containing object, clock

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2. For x2(t):

As seen from the figure the function in the question 4b is y=x which is odd so the Fourier series coefficients of the function would be purely imaginary and odd. A picture containing object, antenna

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