EECS 360 Signal and System Analysis
Lab 6. Continuous Time Fourier Series

Considering a square wave signal $x(t)$ with time $0 \le t \le 2$. The Fourier Series representation in general of $x(t)$ can be expressed as:

$$X_n(t) = \frac{4}{\pi} . \frac{1}{2n-1} \cos\left((2n-1) . \omega_0 t - \frac{\pi}{2} \right)$$

Write a Matlab program to calculate the approximation of the signal $x(t)$ by using the equation above. The number of terms K=[1:500].

The approximation error is defined as:

$$e_n(t) = x(t) - X_n(t)$$

Use *square* function in Matlab to generate the ideal square wave signal. The function is similar to *sin* and *cos* function, but it creates a periodic signal with peak values of ± 1.

$$ideal = square(\omega_0 * t)$$

Graph $X_{10}(t)$, $X_{100}(t)$, $X_{500}(t)$ along with the approximation error associated with them. (Use subplots, the subplot indexes are 231,232, and etc)

The mean square error (MSE) of the approximation is defined as:

$$\varepsilon_k = E\left[\left| e_k(t) \right|^2 \right]$$

Plot the MSE w.r.t the number of terms, discuss the convergence.