6-Labwork - Fourier Series Coefficients & Parseval's Relation

- You **cannot** use SYMBOLIC TOOLBOX.

Show that the Parseval's Relation is satisfied for the periodic signal, $x(t) = x(t+T)$, by evaluating both sides of the equation in (2). One period of **the integral of the signal x(t)** is given in (1).

Please follow these steps to get full credit!!!

Step 1: Define "**integral of the x(t)**" signal given in Equation (1) as a **single row vector**.

$$\int x(t)dt = \begin{cases} -e^{-t} & for \quad 0 \leq t \leq 5 \\ -\sin(2\pi f t + \theta) & for \quad 5 < t \leq 10 \end{cases} \tag{1}$$

where T=10 s, dt=0.001 s, f=0.2 Hz, θ=6dt

Step 2: Find the "**x(t)**" signal and name it "**x_cal**" (You are not allowed to use any MATLAB's build-in function or Symbolic toolbox and manual solutions will not be accepted.)

- *x_cal =1* for *t=0*
- Be careful that the length of the **integral of the x(t)** needs to be equal to the length of the **x_cal(t).**

Step 3: Plot the signals found in **Step 1** and **Step 2** by using **hold on**

- X axis of the Figure needs to be *t.*

Step 4: Find right-hand side of the Equation (2) (You are not allowed to use any MATLAB's build-in function or Symbolic toolbox)

$$\sum_{k=-\infty}^{\infty} |c_k|^2 = \frac{1}{T}\int_0^T |x(t)|^2 dt \tag{2}$$

Step 5: Find complex c_k values for each k by using Equation (3)

- No need to calculate infinite number of coefficients→ k=-5000:1:5000

$$c_k = \frac{1}{T}\int_0^T x(t)e^{-ikwt}dt \tag{3}$$

$$w = \frac{2\pi}{T}$$

Step 6: Find left-hand side of the Equation (2) by using c_k values found in Step 5.

Step 7: Compare the results of both sides of the Equation (2). Note that the results will be scalar and approximately equal.