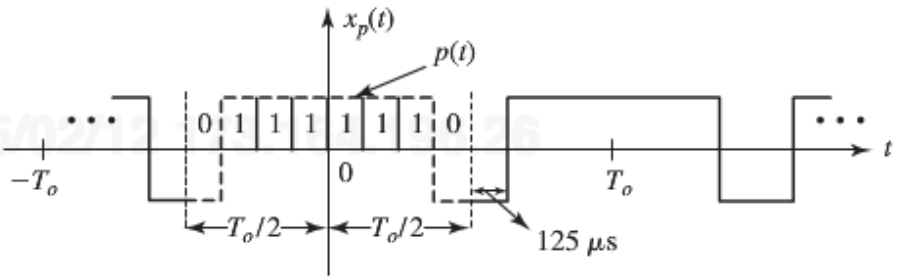
Question 1:

Suppose that a binary information source sends a repetition of pattern 01111110 at a rate of 8 Kbps. A binary 1 is transmitted by sending a rectangular pulse of 1 V with a width of 0.125 ms, and a 0 is transmitted by sending a pulse of −1 V.



a) Find the mathematical expression for the trigonometric Fourier series expansion of the periodic waveform shown above (e.g., you have to find quadrature FS representation).

$$\omega(t) = \sum_{n=0}^{n=\infty} a_n \cos n\omega_0 t + \sum_{n=1}^{n=\infty} b_n \sin n\omega_0 t,$$

b) Calculate the value of the DC coefficient, b_o and/or a_o).
c) What is the fundamental frequency for $x_p(t)$?
d) What are the second and third harmonics of $x_p(t)$?
e) Using **Matlab** plot one-sided magnitude spectrum for $x_p(t)$ from [1 KHz-40 KHz] (e.g., nf_o=40 KHz and you are plotting $|a_n|$ and/or $|b_n|$).
f) Re-plot Part (e) but this time assume the fundamental frequency has been doubled. What happens? Explains.

Question 2:

Assume v(t) represents a bipolar signal as shown below with maximum Vpp=10V.
a) Find the mathematical representation for exponential FS representation of v(t), Cn.
b) Using your findings in Part (a), find the mathematical representation for quadrature FS representation of v(t).
c) Plot part (b) for the first 7 harmonics.
d) In terms of PSD, what is the ratio of power in dB in the fundamental frequency compared to the seventh harmonic? That is $|C_o/C_7|^2$ in dB.