Problem 1

(a)  \[ x(t) \rightarrow G(j2\pi f) \rightarrow p(t-(n-1)T_s) \rightarrow \cdots \rightarrow q(t-(n-1)T_s) \rightarrow y(t) \]

(b)  \[ p(t) = p(t+T_s) = \sum_{l=1}^{L} \xi_l e^{j2\pi l f_s t} \]
\[ q(t) = q(t+T_s) = \sum_{m=1}^{M} \eta_m e^{j2\pi m f_s t} \]

(c)  

Figure 1: n-path system.

The figure above shows an n-path system. \( G \) represents an LTI system.

a. Determine an expression for the harmonic transfer functions \( H_k(j2\pi f) \) of one arm of the system (between A and B).

b. Assuming that \( |G| \) is as shown in part (b) of the figure, draw a qualitative picture of \( |H_k(j2\pi f)| \).

c. Next, determine the harmonic transfer functions \( \hat{H}_k(j2\pi f) \) of the n-path system.

Problem 2

Determine the harmonic transfer functions of the system of Fig. 2, assuming \( \alpha \) and \( t_o \) are 0. What do you notice? Next, evaluate the HTFs for small, non-zero \( \alpha \) but \( t_o = 0 \). Repeat for \( \alpha = 0 \) but small non-zero \( t_o \).

Figure 2: System in Problem 2.