In the Name of God

Communication Systems (25751-1)
Quiz 01

Department of Electrical Engineering
Sharif University of Technology

Instructor: Dr. M. Pakravan
Exam Duration: 60 minutes

Problem 1

Let $x(t)$ be a periodic signal depicted in figure 1.

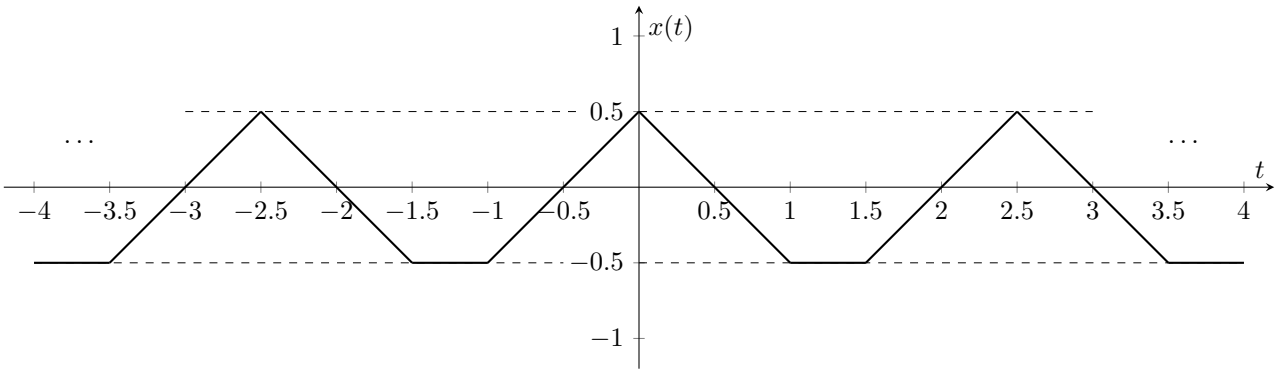

Figure 1

1. **Find** $X(f)$, the Fourier transform of $x(t)$.
2. Suppose $x(t)$ passes through an LTI system with the following impulse response:

$$h(t) = 2.5\,\mathrm{sinc}\left(\frac{t}{2}\right)$$

   The output signal is denoted by $y(t)$. **Find** P_y, the *power* of the output signal.
3. Now assume that the value of P_y is in *watts*. Suppose the signal $y(t)$ is to be transmitted via a 400 km repeater system consisting of m identical fiber optic cable sections with attenuation $\alpha = 0.5797$dB/km and m identical amplifiers. **Find the *minimum* required number of sections** and **gain per amplifier** so that $P_{out} = P_{in}$ and the input power to each amplifier is at least 300 μW.

Problem 2

Let $x(t)$ be a signal passed through the system in figure 2. The system consists of two parallel subsystems described below:

$$h_1(t) = \sum_{k=1}^{n} \frac{2}{k} \text{sinc}(t) \cos\left((2k-1)\pi t\right)$$

$$H_2(f) = \begin{cases} \frac{1}{n} & |f| \geq n \\ 0 & |f| < n \end{cases}$$

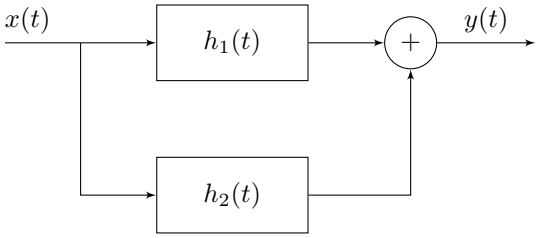

Figure 2

1. **Plot** $H(f) = \dfrac{Y(f)}{X(f)}$, the frequency response of the whole system in figure 2.
2. Suppose the input to the system is

$$x(t) = \frac{1}{\pi t} \sum_{k=0}^{n-1} \cos(2k\pi t)$$

   Plot $X(f)$, the Fourier transform of $x(t)$.
3. **Find** $y(t)$, the output of the system.