Homework Assignment 7

Due: 14:00pm Tuesday, Mar. 21, 2023

Problem 1. Specify the Nyquist rate and the Nyquist interval for the signal $g(t) = \text{sinc}^2(400t)$.

Problem 2. Consider a sinusoidal wave $g(t) = \sin(\pi t)$. Determine the Fourier transform of the instantaneously sampled signal for the following sampling periods and draw the magnitude spectrum:

(a) $T_s = 0.25$ sec

(b) $T_s = 1.5$ sec

Problem 3. A baseband signal $g(t)$ with bandwidth 50 Hz is sampled at the Nyquist rate and the resulting sampled values are

$$g(nT_s) = \begin{cases} -1 & n = -1, -2, \\ 1 & n = 1, 2 \\ 0 & \text{otherwise} \end{cases}.$$

(a) Find $g(0.015)$ from its reconstruction.

(b) Is the signal $g(t)$ a power signal or energy signal?

Problem 4. A PAM wave is produced by the message

$$m(t) = 2\sin(2\pi f_m t).$$

Assume that the modulation frequency $f_m = 0.2$ Hz, sampling period $T_s = 1$s, and pulse duration (with rectangular pulse shape)

$$T = 0.4s$$

(a) Plot the PAM wave (time-domain): $s(t) = \sum_{n=-\infty}^{\infty} m(nT_s)h(t - nT_s)$.

(b) Find the frequency spectrum of the PAM wave $S(f)$.