EE150 Signal and System
Homework 6

Due on 23: 59, June 4, 2024.

Note:

- Please provide enough calculation process to get full marks.
- Please submit your homework to Blackboard in PDF version.
- It's highly recommended to write every exercise on a single sheet of page.
- Late submissions will have points deducted according to the penalty policy.
- Please use English only to complete the assignment, solutions in Chinese are not allowed.
- Plagiarizer will get zero points.
- The full score of this assignment is 100 points.

Exercise 1. (34pt)

Shown in Figure 1 is a system in which the sampling signal is an impulse train with alternating sign. The Fourier transform of the input signal is as indicated in the figure.

(a) For $\Delta < \pi/(2\omega_M)$, sketch the Fourier transform of $x_p(t)$ and $y(t)$.

(b) For $\Delta < \pi/(2\omega_M)$, determine a system that will recover $x(t)$ from $x_p(t)$.

(c) For $\Delta < \pi/(2\omega_M)$, determine a system that will recover $x(t)$ from $y(t)$.

(d) What is the *maximum* value of Δ in relation to ω_M for which $x(t)$ can be recovered from either $x_p(t)$ or $y(t)$?

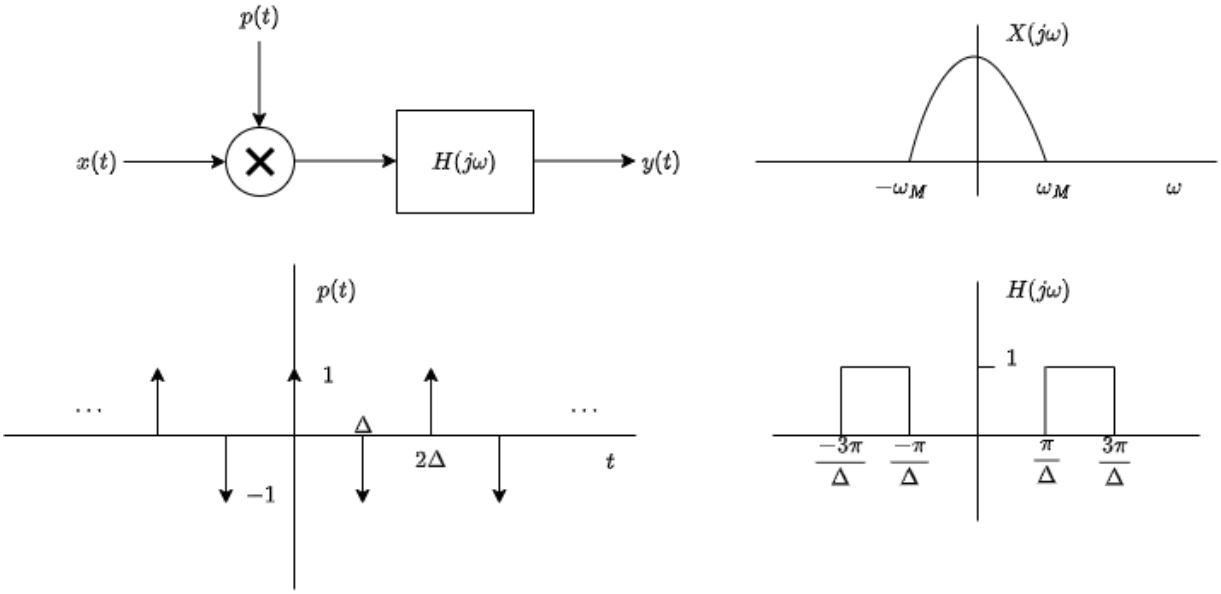

Figure 1

Exercise 2. (33pt)

In the system in Figure 2, $x(t)$ is sampled with a periodic impulse train, and a reconstructed signal $x_r(t)$ is obtained from the samples by low-pass filtering. The sampling period T is $1ms$, and $x(t)$ is a sinusoidal signal of the form $x(t) = \cos(2\pi f_0 t + \theta)$. For each of the following choices of f_0 and θ, determine $x_r(t)$.

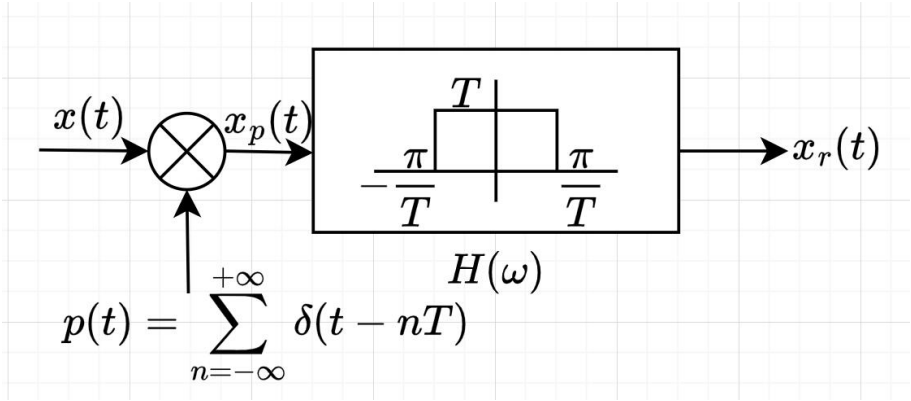

Figure 2

(a) $f_0 = 250Hz$, $\theta = \pi/4$

(b) $f_0 = 750Hz$, $\theta = \pi/2$

(c) $f_0 = 500Hz$, $\theta = \pi/2$

Exercise 3. (33pt)

Consider the system in Figure 3.
Sketch $X_p(\omega)$ for $-9\pi \leq \omega \leq 9\pi$ for the following values of ω_0.

(i) $\omega_0 = \pi$

(ii) $\omega_0 = 3\pi$

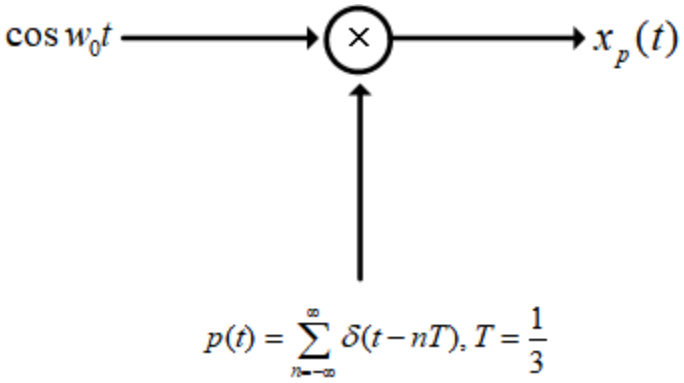

Figure 3