

ELEC 309

Signals and Systems

Homework 7 Assignment

Frequency-Domain Analysis of Signals and Systems

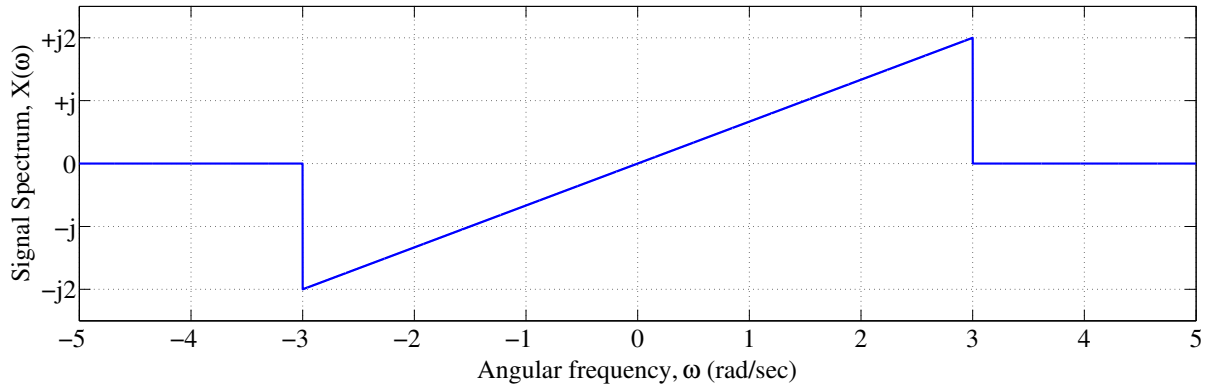


Figure 1: Signal spectrum $X(\omega)$ for Problem 1

1. For the Fourier spectrum $X(\omega)$ shown in Figure 1:
 - (a) Determine a single mathematical expression for the Fourier spectrum $X(\omega)$.
*Hint: You should use the **rect()** function discussed in class!*
 - (b) Find signal $x(t)$ by using the inverse Fourier transform integral (Equation 33 in the class notes).
 - (c) Find signal $x(t)$ by using the table of Fourier transform pairs and the Differentiation in the Time Domain property (Equation 40 in the class notes).

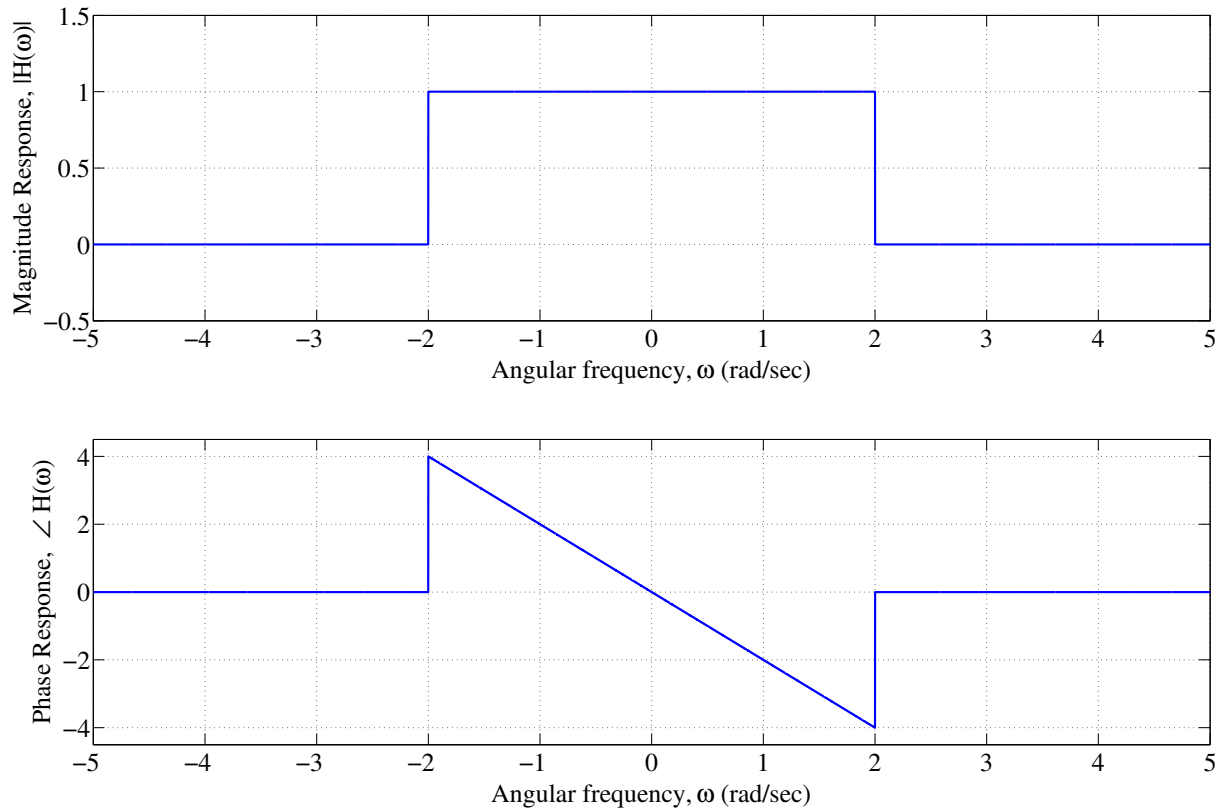


Figure 2: Frequency response $H(\omega)$ for Problem 1

- (d) Determine a single mathematical expression for the frequency response $H(\omega)$ shown in Figure 2. *Hint: You should use the **rect()** function discussed in class!*
- (e) For the LTI system with frequency response $H(\omega)$ shown in Figure 2, determine the impulse response $h(t)$ by using the table of Fourier transform pairs and the Time Shifting property (Equation 35 in the class notes).
- (f) For the LTI system with frequency response $H(\omega)$ shown in Figure 2, determine if the system is causal.
- (g) For the LTI system with frequency response $H(\omega)$ shown in Figure 2, determine the output Fourier spectrum $Y(\omega)$ if the input signal to the LTI system is $x(t)$.
- (h) For the LTI system with frequency response $H(\omega)$ shown in Figure 2, determine the output signal $y(t)$ if the input signal to the LTI system is $x(t)$.

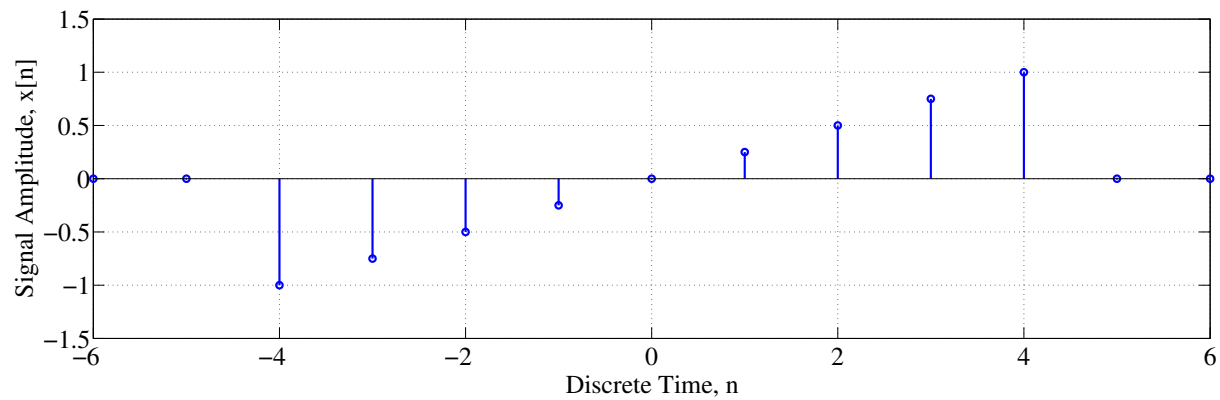


Figure 3: Discrete-time signal $x[n]$ for Problem 2

2. For the discrete-time signal $x[n]$ shown in Figure 3:

(a) Determine the Fourier spectrum $X(\Omega)$. Simplify your answer as much as possible.

(b) Determine the fundamental period for the spectrum $X(\Omega)$.