

ECE355 Signals and Systems

Homework #4

Due day: 04/26/2024

1. Using the definition, find the Fourier transforms of the signals $f(t)$ shown in figure 5-1. (FT definition: $F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t} dt$)

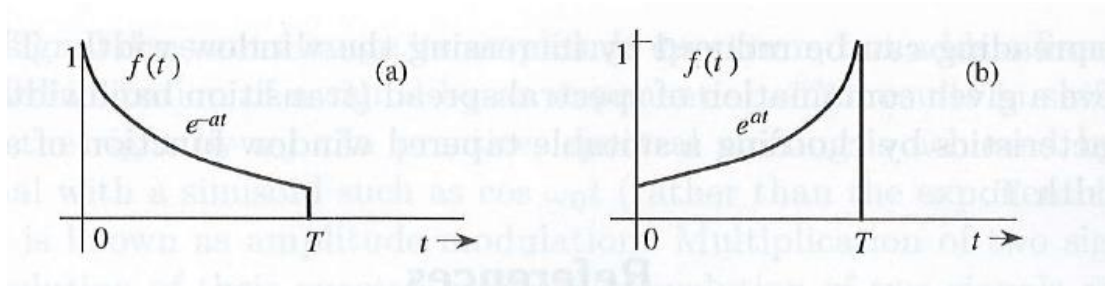


Figure 5-1

2. Using the definition, find the Inverse Fourier transforms of the spectra

$F(\omega)$ shown in figure 5-2. (Inverse FT definition: $f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega)e^{j\omega t} d\omega$)

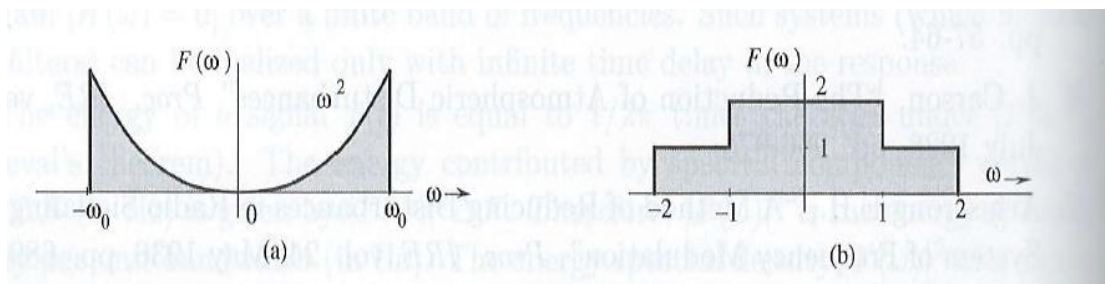


Figure 5-2

3. Find FT of following signals (Recommend using the FT table):

(1). $f(t) = \sin(3\pi t) \cos(10\pi t)$

(2). $f(t) = e^{-2(t-2)} u(t-2)$

(3). $f(t) = 10e^{-5t} u(t) + 8(t-1)e^{-3(t-1)} u(t-1)$

4. The Fourier transform of the triangular signal $f(t)$ shown in the figure 5-3(a) is:

$$F(\omega) = \frac{1}{\omega^2} (e^{j\omega} - j\omega e^{j\omega} - 1)$$

Using the time-shifting and time-scaling properties, find the Fourier transforms of the signals $f_1(t)$ and $f_2(t)$, which are shown in the figure 5-3 (b) and (c), respectively.

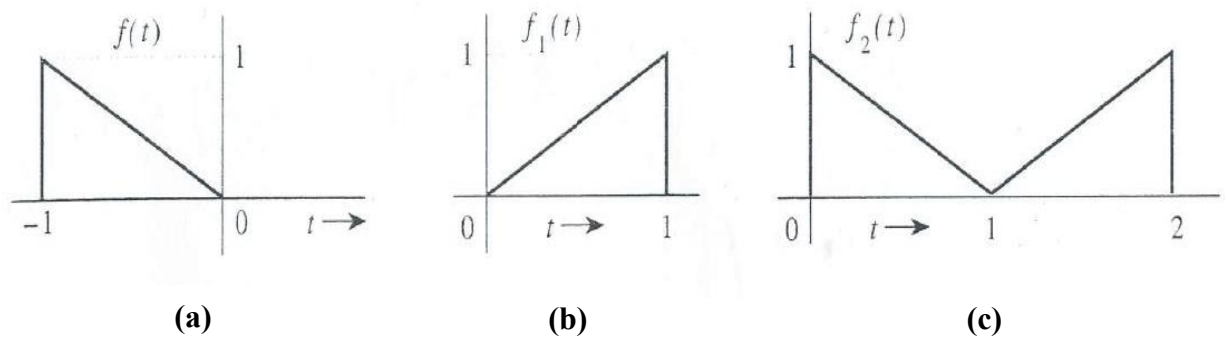


Figure 5-3

5. Please find FT $F(\omega)$ of following functions.

$$(1) \ f(t) = e^{-5t} u(t) * e^{-3t} u(t)$$

$$(2) \ f(t) = e^{5t} u(-t) * e^{-3t} u(t)$$

$$(3) \ f(t) = \sin(3\pi t) * \delta(t - 2)$$

6. For an LTIC system with transfer function:

$$H(\omega) = \frac{5}{(j\omega+1)(j\omega+3)}$$

Find the (zero-state) response $y(t)$, if the input $f(t)$ is:

$$(a). \ 2e^{-2t} u(t)$$

$$(b). \ e^t u(-t)$$