EE103 Fall2017 HW#7

November 13, 2017

1.

6.20. The Fourier transform $X(\omega)$ of a signal $x(t)$ appears in Figure P6.20. The signal $x(t)$ is sampled with an impulse train $p(t)$ to form a new signal $\hat{x}(t) = x(t)p(t)$. The Fourier transform of $p(t)$ is $P(\omega) = 4\sum_{k=-\infty}^{\infty}\delta(\omega - 4k)$. Sketch the Fourier transform of $\hat{x}(t)$.

Chap. 6 Problems **329**

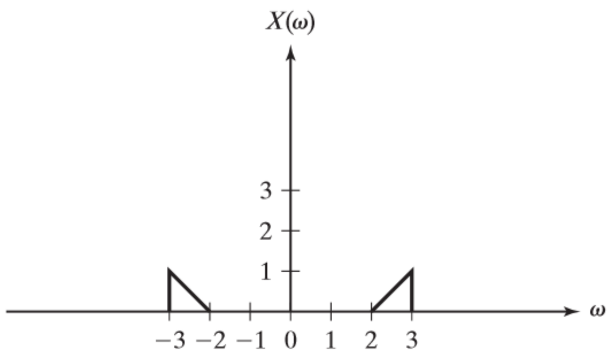

Figure P6.20

2.

6.27. For the system of Figure P6.27, sketch $A(\omega)$, $B(\omega)$, $C(\omega)$, and $Y(\omega)$. Show all amplitudes and frequencies.

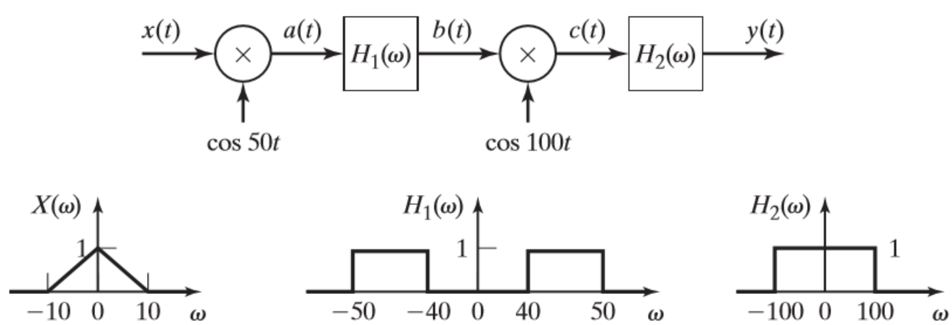

Figure P6.27

3.

6.30. In QAM [8], it is possible to send two signals on a single channel, which effectively doubles the bandwidth of the channel. QAM is used in the uplink (path from the house to the service provider) in today's 56,000 bits/second modems, in DSL modems, and in Motorola's Nextel cellular phones.

A block diagram of a QAM system is shown in Figure P6.30. Assume that $f_1(t)$ and $f_2(t)$ have bandwidth ω_0, where $\omega_0 \ll \omega_c$ and ω_c is the carrier frequency.

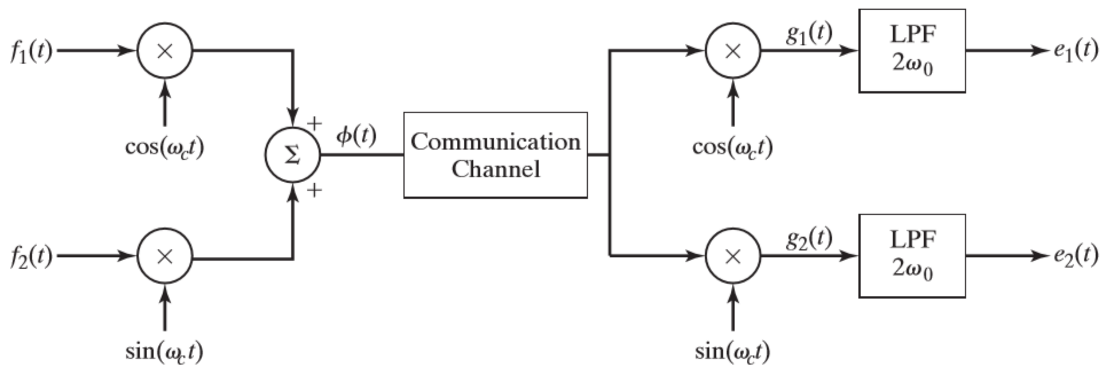

Figure P6.30

You will find the trigonometric identities in Appendix A useful for solving this problem.

We form the following signals, as shown in Figure P6.30:

$$\phi(t) = f_1(t)\cos \omega_c t + f_2(t) \sin \omega_c t$$
$$g_1(t) = \phi(t) \cos \omega_c t$$
$$g_2(t) = \phi(t) \sin\omega_c t$$

(a) Determine the signal $g_1(t)$.

(b) Determine the signal $g_2(t)$.

(c) As shown in Figure P6.30, $g_1(t)$ and $g_2(t)$ are filtered by ideal low-pass filters, with cutoff frequency of $2\omega_0$ and unit amplitude, to form the output signals $e_1(t)$ and $e_2(t)$. Determine $e_1(t)$ and $e_2(t)$.