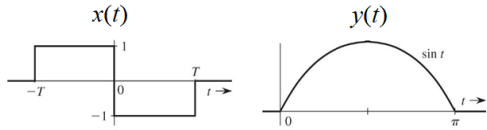


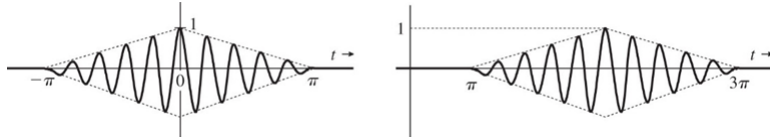
# ENGR 3323: Signals and Systems

## HW 11\_Ch7

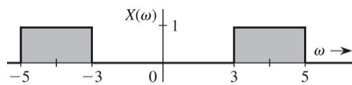
**Q1)** Find the Fourier transforms (FT) of the signals shown below using only the time-shifting property and the FT Table.



**Q2)** The signals below are modulated signals with carrier  $\cos(10t)$ . Find the Fourier transforms of these signals by using the Fourier transform properties and the FT table. Sketch the amplitude and phase spectra for the signals.



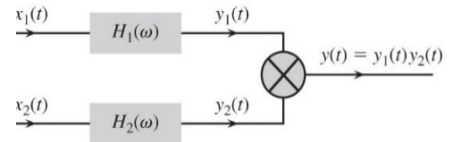
**Q3)** Use the frequency-shifting property and the FT Table to find the inverse Fourier transform of the spectra shown below



**Q4)** For a stable LTIC system with transfer function  $H(s) = 1/(s + 1)$  find the (zero-state response) if the input  $x(t)$  is  
 a)  $e^{-2t}u(t)$       b)  $e^{-t}u(t)$       c)  $e^t u(-t)$       d)  $u(t)$

**Q5)** Signals  $x_1(t) = 10^4 \text{rect}(10^4 t)$  and  $x_2(t) = \delta(t)$  are applied at the inputs of the ideal low-pass filters shown below  $H_1(\omega) = \text{rect}(\omega/40,000\pi)$  and  $H_2(\omega) = \text{rect}(\omega/20,000\pi)$ . The outputs  $y_1(t)$  and  $y_2(t)$  of these filters are multiplied to obtain the signal  $y(t) = y_1(t)y_2(t)$ .

- a) Sketch  $X_1(\omega)$  and  $X_2(\omega)$ .      b) Sketch  $H_1(\omega)$  and  $H_2(\omega)$ .  
 c) Sketch  $Y_1(\omega)$  and  $Y_2(\omega)$ .      d) Find the bandwidths of  $y_1(t)$ ,  $y_2(t)$ , and  $y(t)$ .



**Q6)** For the signal  $x(t) = \frac{2a}{t^2+a^2}$  determine the essential bandwidth  $B$  (in hertz) of  $x(t)$  such that the energy contained in the spectral components of  $x(t)$  of frequencies below  $B$  Hz is 99% of the signal energy  $E_x$ .

**Q7)** Figure below shows a scheme to transmit two signals  $m_1(t)$  and  $m_2(t)$  simultaneously on the same channel (without causing spectral interference). Such a scheme, which transmits more than one signal, is known as signal *multiplexing*. In this case, we transmit multiple signals by sharing an available spectral band on the channel, and, hence, this is an example of the *frequency-division* multiplexing. The signal at point  $b$  is the multiplexed signal, which now modulates a carrier of frequency 20,000 rad/s. The modulated signal at point  $c$  is now transmitted over the channel.

- a) Sketch the spectra at points  $a$ ,  $b$ , and  $c$ .      b) What must be the minimum bandwidth of the channel?  
 c) Design a receiver to recover signals  $m_1(t)$  and  $m_2(t)$  from the modulated signal at point  $c$ .

