

PROBLEM:

The signal $x(t)$ is formed from the signal $v(t)$ by AM modulation. Assume that

$$v(t) = 3 + 3 \cos(5t + \pi/3)$$

and that

$$x(t) = v(t) \cos(20t).$$

- (a) Draw the spectrum for $v(t)$.
- (b) Draw the spectrum for $x(t)$.



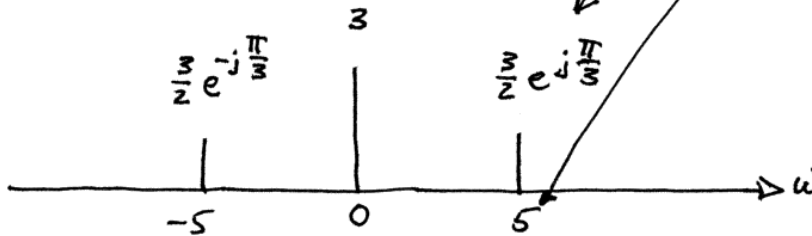
The signal $x(t)$ is formed from the signal $v(t)$ by AM modulation. Assume that

$$v(t) = 3 + 3 \cos(5t + \pi/3) = 3 + \frac{3}{2} e^{j\frac{\pi}{3}} e^{j5t} + \frac{3}{2} e^{-j\frac{\pi}{3}} e^{-j5t}$$

and that

$$x(t) = v(t) \cos(20t)$$

- (a) Draw the spectrum for $v(t)$. Your sketch should be clearly labeled and all complex amplitudes should be indicated.



- (b) Draw the spectrum for $x(t)$. Your sketch should be clearly labeled and all complex amplitudes should be clearly indicated.

$$\begin{aligned} x(t) &= v(t) \cos(20t) \\ &= \left[3 + \frac{3}{2} e^{j\frac{\pi}{3}} e^{j5t} + \frac{3}{2} e^{-j\frac{\pi}{3}} e^{-j5t} \right] \cdot \frac{1}{2} \left[e^{j20t} + e^{-j20t} \right] \\ &= \frac{3}{2} e^{j20t} + \frac{3}{4} e^{j\frac{\pi}{3}} e^{j25t} + \frac{3}{4} e^{-j\frac{\pi}{3}} e^{j15t} \\ &\quad + \frac{3}{2} e^{-j20t} + \frac{3}{4} e^{j\frac{\pi}{3}} e^{-j15t} + \frac{3}{4} e^{-j\frac{\pi}{3}} e^{-j25t} \end{aligned}$$

