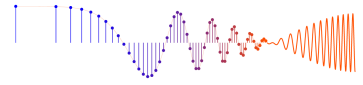




**EXERCISE 11.13:** Show that the frequency response  $H(j\omega)$  in (11.96) is periodic in  $\omega$  with period  $2\pi/t_d$ .



$$H(j\omega) = 1 + \alpha e^{-j\omega t_d}$$

Period =  $2\pi/t_d$ , so we try

$$\begin{aligned} H(j(\omega + 2\pi/t_d)) &= 1 + \alpha e^{-j(\omega + 2\pi/t_d)t_d} \\ &= 1 + \alpha e^{-j(\omega t_d + 2\pi)} \\ &= 1 + \alpha e^{-j\omega t_d} \underbrace{e^{-j2\pi}}_{=1} \\ &= 1 + \alpha e^{-j\omega t_d} \\ &= H(j\omega) \end{aligned}$$

Thus,  $H(j\omega)$  is periodic with period =  $\frac{2\pi}{t_d}$ .