Solution

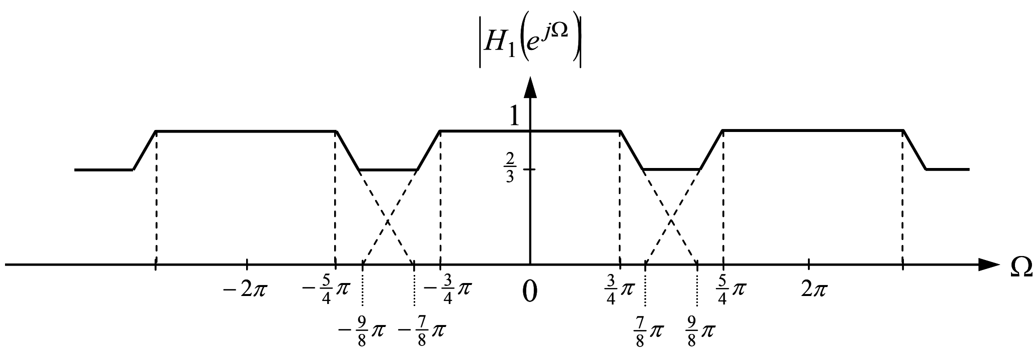
(a) Since $h_1[n] \overset{Z}{\leftrightarrow} H_1(z)$ is designed using the impulse invariance criterion, we have:

$$H_1\left(e^{j\omega T}\right) = \sum_{l=-\infty}^{\infty} H_c\left(j\left(\omega - \frac{l2\pi}{T}\right)\right),$$

In terms of discrete-time frequency Ω, we have:

$$H_1\left(e^{j\Omega}\right) = \sum_{l=-\infty}^{\infty} H_c\left(j\left(\frac{\Omega - l2\pi}{T}\right)\right).$$

A plot of $\left|H_1\left(e^{j\Omega}\right)\right|$ is shown below. Aliasing occurs because the sampling rate is less than twice the highest frequency in $H_c(j\omega)$.



(b) Since $h_2[n] \overset{Z}{\leftrightarrow} H_2(z)$ is designed using bilinear transformation:

$$H_2\left(e^{j\Omega}\right) = H_c(j\omega),$$

where the discrete-time frequency ω and continuous-time frequency Ω are related by:

$$\Omega = 2\tan^{-1}(\omega T/2).$$

Thus, the passband edge frequency $\omega_c = 18\pi$ maps to $\Omega_c = 2\tan^{-1}(3\pi/8)$, while the stopband edge frequency $\omega_s = 27\pi$ maps to $\Omega_s = 2\tan^{-1}(9\pi/16)$. A plot of $\left|H_2\left(e^{j\Omega}\right)\right|$ is shown below.