Solutions, MM

1) $$|H_{ap}(e^{jw})|^2 = H_{ap}(z) \cdot H^*_{ap}\left(\frac{1}{z^*}\right)\Big|_{z=e^{jw}}$$

$$H_{ap}(z) \cdot H^*_{ap}\left(\frac{1}{z^*}\right) =$$

$$\frac{(z^{-1} - a^*)(z - a)}{(1 - az^{-1})(1 - a^* z)}$$

$$= \frac{1 - a^* z - az^{-1} - a^* a}{1 - az^{-1} - a^* z - a^* a} = 1$$

2) a) $$H_1(z) = \frac{(1 - 0.5z^{-1})(1 + \frac{1}{4}z^{-2})}{(1 - 0.64z^{-2})}$$

$$H_{ap}(z) = \frac{1 + 4z^{-2}}{1 + \frac{1}{4}z^{-2}}$$

b) $$H_2(z) = \frac{(1 - 0.5z^{-1})}{(1 - 0.64z^{-2})(1 + \frac{1}{4}z^{-2})}$$

$$H_{lin}(z) = \left(1 + \frac{1}{4}z^{-2}\right)\left(1 + 4z^{-2}\right)$$

5.3.

$$H(z) = \frac{z^{-1}}{z^{-2} - \frac{10}{3} z^{-1} + 1} = \frac{z^{-1}}{(z^{-1}-3)(z^{-1}-\frac{1}{3})}$$

$$= \frac{z}{(1-3z)(1-\frac{1}{3}z)}$$

(a) Poles: $z=3,\ \frac{1}{3}$ Zeros: $z=0,\ \infty$

(b) $h[n] = -\frac{3}{8}\left(\frac{1}{3}\right)^n u[n] - \left(\frac{3}{8}\right) 3^n u[-n-1]$

5.4. $H_i(z)$ cannot be causal and stable.

The zero of $H(z)$ at $z=\infty$ is a pole of $H_i(z)$.

The existence of a pole at $z=\infty$ implies that the system is not causal.