

$$a) \quad y(n) = x(n-3) + x(n-2) + x(n-1) + x(n)$$

$$Y(z) = X(z) \cdot z^{-3} + X(z) \cdot z^{-2} + X(z) \cdot z^{-1} + X(z)$$

$$Y(z) = X(z) \cdot (z^{-3} + z^{-2} + z^{-1} + 1)$$

$$T(z) = \frac{Y(z)}{X(z)} = z^{-3} + z^{-2} + z^{-1} + 1$$

$$T(z) = \frac{z^3}{z^3} \cdot (z^{-3} + z^{-2} + z^{-1} + 1) = \frac{1 + z^1 + z^2 + z^3}{z^3}$$

Módulo y Fase

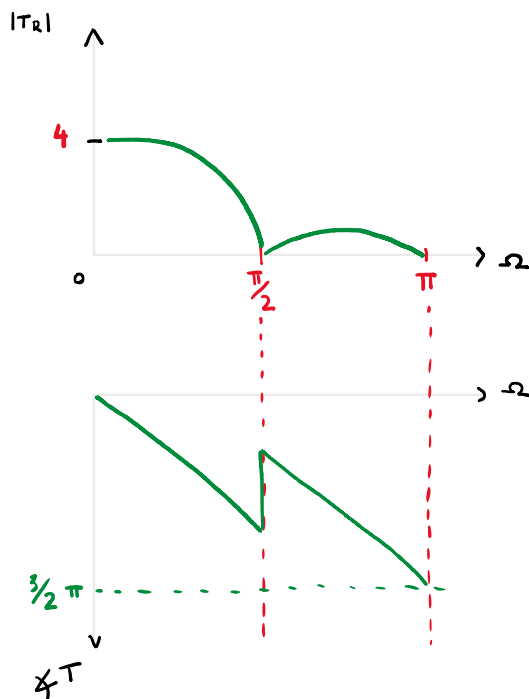
$$T(j\omega) = \frac{e^{j0} + e^{j\omega} + e^{2j\omega} + e^{3j\omega}}{e^{3j\omega}}$$

$$= \frac{e^{j\frac{3}{2}\omega} (e^{-j\frac{3}{2}\omega} + e^{-j\frac{1}{2}\omega} + e^{j\frac{1}{2}\omega} + e^{j\frac{3}{2}\omega})}{e^{3j\omega}}$$

$$= e^{-j\frac{3}{2}\omega} (2 \cos(\frac{3}{2}\omega) + 2 \cos(\frac{1}{2}\omega))$$

$$|T(z)| = |T_R(\omega)| = |2 \cos(\frac{3}{2}\omega) + 2 \cos(\frac{1}{2}\omega)|$$

$$\angle T(z) = -\frac{3}{2}\omega$$



$$2 \cos(\frac{3}{2}\omega) + 2 \cos(\frac{1}{2}\omega) = 0$$

$$2 (\cos(\frac{3}{2}\omega) + \cos(\frac{1}{2}\omega)) = 0$$

$$2 \left[2 \cos\left(\frac{\frac{3}{2}\omega + \frac{1}{2}\omega}{2}\right) \cos\left(\frac{\frac{3}{2}\omega - \frac{1}{2}\omega}{2}\right) \right] = 0$$

$$4 \cdot \cos\left(\frac{\omega}{2}\right) \cdot \cos\left(\frac{\omega}{2}\right) = 0$$

$$4 \cdot \cos(\omega) \cos(\omega/2) = 0$$

$$\cos(\omega) = 0$$

$$\omega = \frac{\pi}{2} + k\pi, \quad k \in \mathbb{N}$$

$$\cos(\omega/2) = 0$$

$$\frac{\omega}{2} = \frac{\pi}{2} + k\pi$$

$$\omega = \pi + 2k\pi, \quad k \in \mathbb{N}$$

