PROBLEM

- Assume that there are three paths (α(0)=0.3, α(1)=1, and α(2)=0.3) in a wireless channel and the delay between any two paths is a symbol period. Find the equivalent baseband ZF equalizer.
- With the built platform in Practice 1 and the assumed channels, conduct digital ZF equalization to recovery the transmit symbol signal (QPSK).

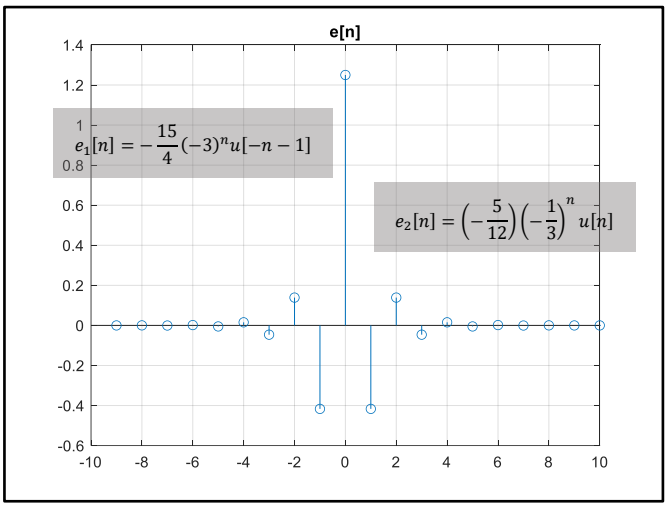
I. Find the equivalent baseband ZF equalizer

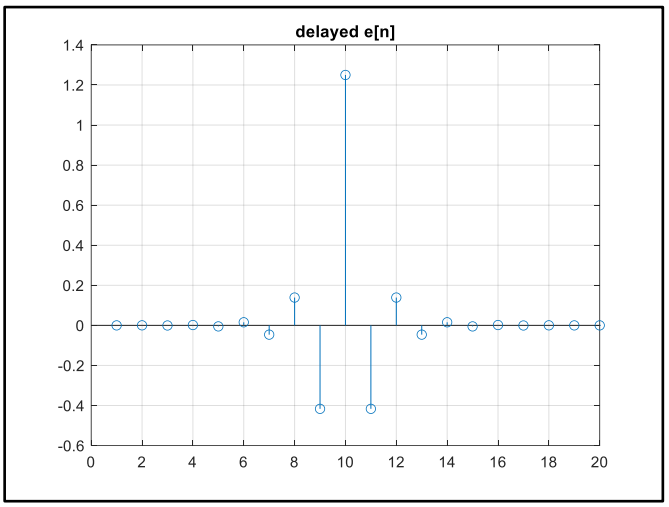
$$\mathrm{H(z)} = 0.3 + \mathrm{z}^{-1} + 0.3\mathrm{z}^{-2}$$

$$\Rightarrow \mathrm{E(z)} = \frac{1}{\mathrm{H(z)}} = \frac{1}{0.3 + \mathrm{z}^{-1} + 0.3\mathrm{z}^{-2}} = \frac{\frac{15}{4}}{1 + 3z^{-1}} + \frac{-\frac{5}{12}}{1 + \frac{1}{3}z^{-1}} = E_1(z) + E_2(z)$$

$$\text{for stable system, } \begin{cases} E_1(z) = \dfrac{\frac{15}{4}}{1 + 3z^{-1}} \\ E_2(z) = \dfrac{-\frac{5}{12}}{1 + \frac{1}{3}z^{-1}} \end{cases} \Rightarrow \begin{cases} e_1[n] = -\dfrac{15}{4}(-3)^n u[-n-1] \\ e_2[n] = \left(-\dfrac{5}{12}\right)\left(-\dfrac{1}{3}\right)^n u[n] \end{cases} \Rightarrow \mathrm{e[n]} = e_1[n] + e_2[n]$$

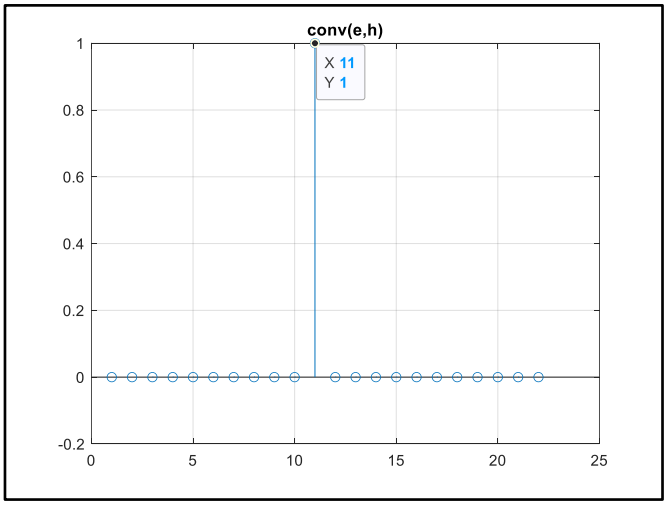
設定 equalizer 長度為 20，做 truncation 成為下圖左，再 delay 10 成為下圖右的 causal filter。





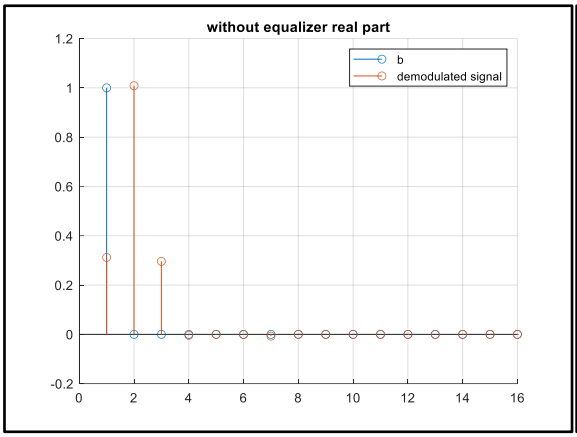
equalizer 有 delay 10
⇒ equalizer 和 baseband channel response 做 convolution 後得到的 delta function 也會 delay 10。
⇒ 最後做 recovery 的訊號也會 delay 10，需要額外補回來。

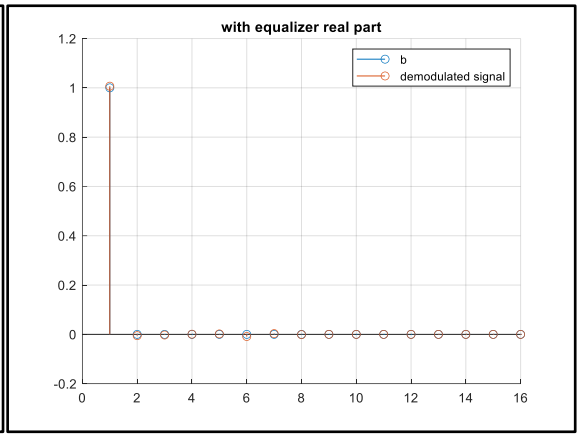
```
91    % equalizer
92    rxd1 = conv(rxd1, e);
93    rxd1 = rxd1(1+Ne:end);
```



II. Conduct digital ZF equalization to recovery the transmit symbol signal (QPSK)

A. Transmit symbol signal = delta function





B. Transmit symbol signal = QPSK signal