Problem 6.18

(a) The impulse response of the data-transmission system is defined by (see Fig. 1)

$c_n = \{0.0, 0.15, 0.68, -0.22, 0.08\}$

Using a three-tap transversal filter for zero-forcing equalization, we write in accordance with Eq. (6.43):

$$\begin{bmatrix} 0.68 & 0.15 & 0.0 \\ -0.22 & 0.68 & 0.15 \\ 0.08 & -0.22 & 0.68 \end{bmatrix} \begin{bmatrix} w_{-1} \\ w_0 \\ w_1 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \tag{1}$$

In Eq. (1), we have set $\sqrt{E} = 1$ to simplify the presentation. Solving this simultaneous system of three equations, we obtain the tap-weight (parameter) vector,

$$\mathbf{w} = \begin{bmatrix} w_{-1} \\ w_0 \\ w_1 \end{bmatrix} = \begin{bmatrix} 0.68 & 0.15 & 0.0 \\ -0.22 & 0.68 & 0.15 \\ 0.08 & -0.22 & 0.68 \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

$$= \begin{bmatrix} -0.2825 \\ 1.2805 \\ 0.4475 \end{bmatrix} \tag{2}$$

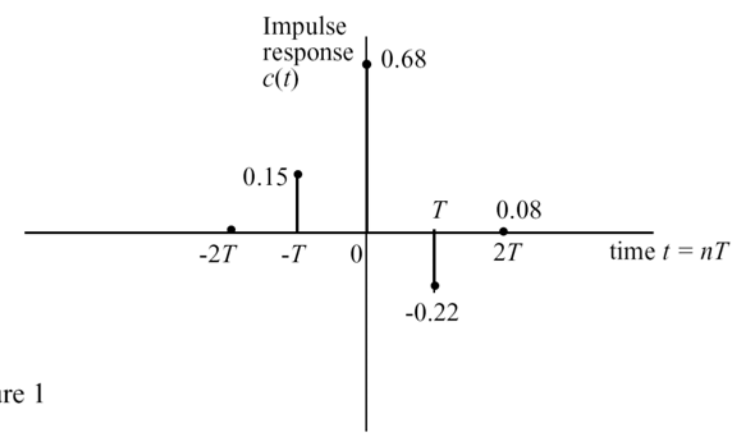

Figure 1

Continued on next slide

Problem 6-18 continued

(b) The residual intersymbol interference produced at the equalizer output is given by

$$\mathbf{z} = \mathbf{c}\mathbf{w} \tag{3}$$

where

$$\mathbf{c} = \begin{bmatrix} 0.15 & 0.0 & 0.0 \\ 0.68 & 0.15 & 0.0 \\ -0.22 & 0.68 & 0.15 \\ 0.08 & -0.22 & 0.68 \\ 0.0 & 0.08 & -0.22 \end{bmatrix} \tag{4}$$

Therefore, using Eqs. (4) and (2) in (3), we get the residual interference vector

$$\mathbf{z} = \begin{bmatrix} -0.0424 \\ 0 \\ 1 \\ 0 \\ 0.004 \end{bmatrix} \tag{5}$$

(c) From Eq. (5), we see that the largest contribution to the residual interference is