Problem 6.19

In this problem, the transversal zero-forcing equalizer has five adjustable weights. As in Problem 6.18, the unequalized impulse response is defined by

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

Accordingly, application of Eq. (6.43) yields (again setting $\sqrt{E} = 1$ to simplify the presentation)

$$\underbrace{\begin{bmatrix} 0.68 & 0.15 & 0.0 & 0.0 & 0.0 \\ -0.22 & 0.68 & 0.15 & 0.0 & 0.0 \\ 0.08 & -0.22 & 0.68 & 0.15 & 0.0 \\ 0.0 & 0.08 & -0.22 & 0.68 & 0.15 \\ 0.0 & 0.0 & 0.08 & -0.22 & 0.68 \end{bmatrix}}_{\mathbf{c}} \underbrace{\begin{bmatrix} w_{-2} \\ w_{-1} \\ w_0 \\ w_1 \\ w_2 \end{bmatrix}}_{\mathbf{w}} = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix} \tag{1}$$

Solving this system of five simultaneous equations for the tap-weight vector, we get

$$\mathbf{w} = \begin{bmatrix} -0.0581 \\ -0.2635 \\ 1.2800 \\ 0.4465 \\ -0.0061 \end{bmatrix} \tag{2}$$

Comparing Eq. (1) of this problem with Eq. (1) of the previous problem, we see some basic differences and therefore consequences:

(i) Unlike Problem 6.18, the 5-by-5 metric **c** in Eq. (1) has a row (namely, the third row) which completely describes the unequalized impulse response of the data-transmission system.

(ii) As a consequence of point (i), the 5-by-1 parameter vector **w** produces complete equalization of the system; that is, unlike Problem 6.18, there is no residual intersymbol interference left after equalization.

(iii) The zero residual interference is the result of using a five-tap equalizer which has sufficient degrees of freedom to force each element of the impulse response $\{c_n\}$ down to the desired value of zero.