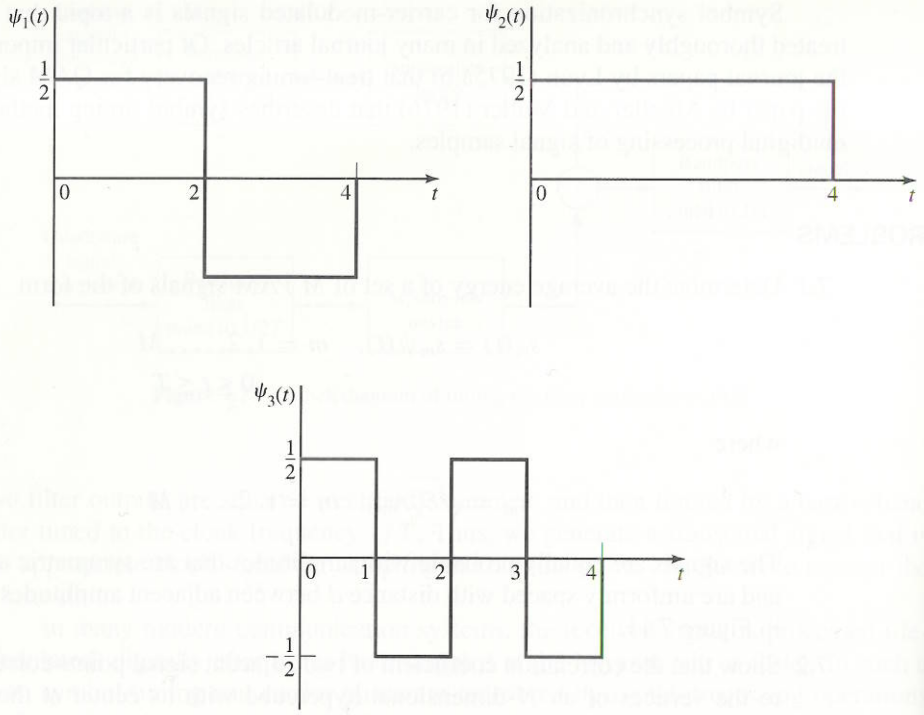

Figure P-7.3

over the interval $0 \le t \le 4$ by the linear combination

$$\hat{x}(t) = \sum_{n=1}^{3} c_n \psi_n(t)$$

1. Determine the expansion coefficients $\{c_n\}$ that minimize the mean-square approximation error

$$E = \int_0^4 [x(t) - \hat{x}(t)]^2 \, dt$$

2. Determine the residual mean square error $E_{\min}$.

7.5 Consider the four waveforms shown in Figure P-7.5.

1. Determine the dimensionality of the waveforms and a set of basis functions.
2. Use the basis functions to represent the four waveforms by vectors $\mathbf{s}_1, \mathbf{s}_2, \mathbf{s}_3, \mathbf{s}_4$.
3. Determine the minimum distance between any pair of vectors.

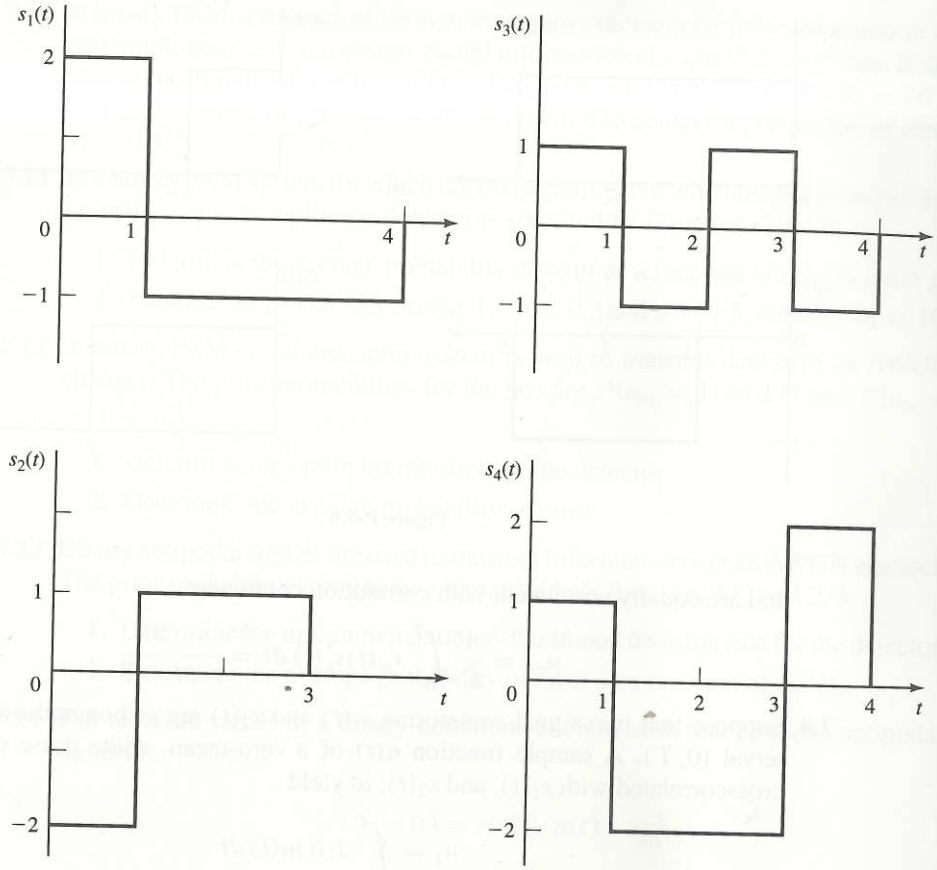

Figure P-7.5

7.6 Determine a set of orthonormal functions for the four signals shown in Figure P-7.6.

7.7 Consider a set of M orthogonal signal waveforms $s_m(t)$, $1 \le m \le M$, $0 \le t \le T$, all of which have the same energy $\mathcal{E}$. Define a new set of M waveforms as

$$s'_m(t) = s_m(t) - \frac{1}{M} \sum_{k=1}^{M} s_k(t), \qquad \begin{matrix} 1 \le m \le M \\ 0 \le t \le T \end{matrix}$$

Show that the M signal waveform $\{s'_m(t)\}$ have equal energy, given by

$$\mathcal{E}' = (M-1)\mathcal{E}/M$$