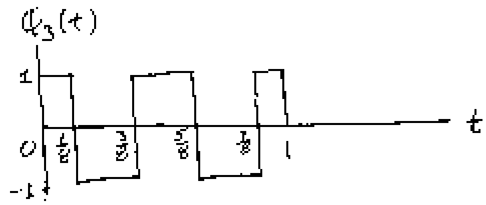
H8-08

4. The fourth Walsh basis signal is defined as shown below



For the signal $x(t) = e^{-t}$, $0 \le t \le 1$, compute and sketch the

(a) minimum integral square error representation using $\phi_0(t), \phi_1(t)$,

(b) minimum integral square error representation using $\phi_2(t), \phi_3(t)$,

(c) minimum integral square error representation using the first 4 Walsh basis signals.

5. Determine values of the coefficients *a*, *b*, and *c* so that the signals

$$\phi_0(t) = ae^{-t} \ , \quad \phi_1(t) = be^{-t} + ce^{-2t}$$

form an orthonormal basis set on the time interval $0 \le t < \infty$.

2. Suppose $x(t)$ is periodic with fundamental period T_o and complex-form Fourier series coefficients X_k . Show that

(a) if $x(t)$ is odd, $x(t) = -x(-t)$, then $X_k = -X_{-k}$ for all *k*.

(b) if $x(t)$ is "half-wave odd," $x(t) = -x(t + T_o / 2)$, then $X_k = 0$ for every even integer *k*.

(c) if $x(t)$ is even, $x(t) = x(-t)$, then $X_k = X_{-k}$ for all *k*.

3. Suppose the signal $x(t)$ has fundamental period T_o and complex-form Fourier series coefficients X_k . Derive expressions for the complex-form Fourier series coefficients of the following signals in terms of X_k .

(a) $\hat{x}(t) = 2x(t-3) + 1$

(b) $\hat{x}(t) = x(1-t)$

(c) $\hat{x}(t) = \frac{d}{dt} x(t)$

(d) $\hat{x}(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$ (What additional assumption is required on the Fourier series coefficients of $x(t)$?) *Hint:* $\hat{X}_k = \frac{1}{T_o} \int_0^{T_o} \int_{-\infty}^{t} x(\tau) d\tau\, e^{-jk\omega_o t}\, dt$ and integration-by-parts can be used to write this in a way that X_k can be recognized.

(e) $\hat{x}(t) = x(t + T_o / 2)$