

4.32. Consider the discrete-time system shown in Figure P4.32-1

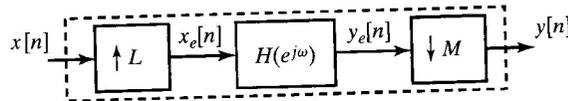


Figure P4.32-1

where

(i)  $L$  and  $M$  are positive integers.

(ii)  $x_e[n] = \begin{cases} x[n/L] & n = kL, \quad k \text{ is any integer} \\ 0 & \text{otherwise.} \end{cases}$

(iii)  $y[n] = y_e[nM]$ .

(iv)  $H(e^{j\omega}) = \begin{cases} M & |\omega| \leq \frac{\pi}{4} \\ 0 & \frac{\pi}{4} < |\omega| \leq \pi. \end{cases}$

(a) Assume that  $L = 2$  and  $M = 4$ , and that  $X(e^{j\omega})$ , the DTFT of  $x[n]$ , is real and is as shown in Figure P4.32-2. Make an appropriately labeled sketch of  $X_e(e^{j\omega})$ ,  $Y_e(e^{j\omega})$ , and  $Y(e^{j\omega})$ , the DTFTs of  $x_e[n]$ ,  $y_e[n]$ , and  $y[n]$ , respectively. Be sure to clearly label salient amplitudes and frequencies.

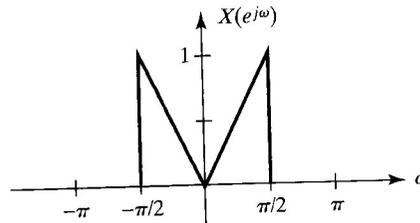


Figure P4.32-2

(b) Now assume  $L = 2$  and  $M = 8$ . Determine  $y[n]$  in this case.  
Hint: See which diagrams in your answer to part (a) change.

4.33. For the system shown in Figure P4.33, find an expression for  $y[n]$  in terms of  $x[n]$ . Simplify the expression as much as possible.

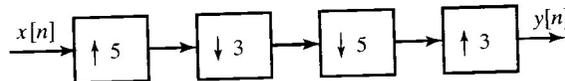


Figure P4.33

### Advanced Problems

4.34. In the system shown in Figure P4.34, the individual blocks are defined as indicated.

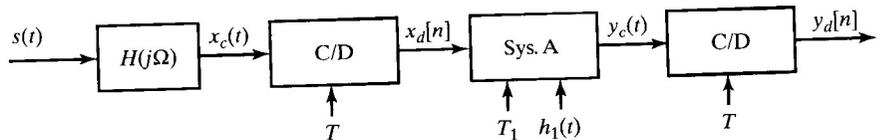


Figure P4.34