EE3900 - Oppenheim and Wilsky A1

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Question 3.16 (c)

The signal $x_3[n]$ is written as

$$x_3[n] = [(\frac{1}{2})^n u[n]] \cdot \sum_{k=-\infty}^{\infty} \delta[n-4k] = g[n] \cdot r[n]$$

where $g[n] = (\frac{1}{2})^n u[n])$ and $r[n] = \sum_{k=-\infty}^{\infty} \delta[n-4k]$. Therefore, $y_3[n]$ may be obtained by passing the signal r[n] through the filter with frequency response $H(e^{jw}$, and then convolving the result with g[n].

The signal r[n] is periodic with period 4 and its Fourier series coefficients are

$$a_k = \frac{1}{4}, forallk$$

The output $q[n]$ obtained by passing $r[n]$ through the filter with frequency response $H(e^{jw})$ is

$$q[n] = \sum_{k=0}^{3} a_k H(e^{j2\pi k/4}(e^{k(2\pi/4)} \tag{1}$$

$$= (\frac{1}{4})(H(e^{j0})e^{j0} + H(e^{j(\pi/2)})e^{j(\pi/2)} + H(e^{j\pi}e^{j\pi} + H(e^{j3(\pi/2)})e^{j3(\pi/2)} \tag{2}$$

$$= 0 \tag{3}$$

therefore, the final output is $y_3[n] = q[n] \cdot g[n] = 0$.