Problem 7.8

Given frequency response of LTI system is:

$H(e^{j\hat{\omega}}) = \cos(3\hat{\omega})$

(a) Output of the system for the input signal, $x_1[n] = \delta[n-3]$:

Taking DTFT, $X(e^{j\hat{\omega}}) = e^{-j\hat{\omega}3}$. Thus, $Y(e^{j\hat{\omega}}) = H(e^{j\hat{\omega}})X(e^{j\hat{\omega}})$.

Hence, $Y(e^{j\hat{\omega}}) = \cos(3\hat{\omega})e^{-j\hat{\omega}3}$.

(b) Output of the system for the input signal, $x_2[n] = 3\cos(0.25\pi n)$:

$y_2[n] = 3|H(e^{j0.25\pi})|\cos(0.25\pi n) = \frac{-3\sqrt{2}}{2}\cos(0.25\pi n)$

$= -1.5\sqrt{2}\cos(0.25\pi n)$

(c) Output of the system for the input signal, $x_3[n] = u[n] - u[n-9]$:

$H(e^{j\hat{\omega}}) = 0.5(e^{j\hat{\omega}3} + e^{-j\hat{\omega}3})$. $h[n] = 0.5(\delta[n+3] + \delta[n-3])$

Thus, $y[n] = x_3[n] * h[n] = (u[n] - u[n-9]) * (0.5\delta[n+3] + 0.5\delta[n-3])$

$= 0.5(u[n+3] + u[n-3] - u[n-6] - u[n-12])$