Assignment - 2

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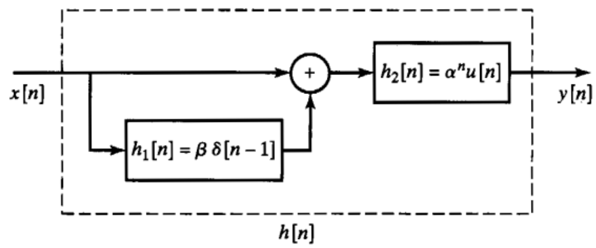
***Abstract*—This document contains the solution to the problem 2.42 (c) of Oppenheimer.**



Solution: From 2.42 (b), we have the frequency response equation

$$H(e^{jw}) = \frac{1+\beta e^{-jw}}{1-\alpha e^{-jw}} \tag{1}$$

$$\frac{Y(e^{jw})}{X(e^{jw})} = \frac{1+\beta e^{-jw}}{1-\alpha e^{-jw}} \tag{2}$$

$$Y(e^{jw})\left(1-\alpha e^{-jw}\right) = X(e^{jw})\left(1+\beta e^{-jw}\right) \tag{3}$$

$$Y(e^{jw}) - \alpha e^{-jw}Y(e^{jw}) = X(e^{jw}) + \beta e^{-jw}X(e^{jw}) \tag{4}$$

Using following properties of inverse Fourier transform,

$$Y(e^{jw}) \overset{\mathcal{F}}{\rightleftharpoons} y[n] \tag{5}$$

$$e^{-ajw}Y(e^{jw}) \overset{\mathcal{F}}{\rightleftharpoons} y[n-a] \tag{6}$$

Applying inverse Fourier transform on (4), we obtain

$$y[n] - \alpha y[n-1] = x[n] + \beta x[n-1] \tag{7}$$

Final difference equation that relates output $y[n]$ to input $x[n]$ is

$$y[n] = x[n] + \alpha y[n-1] + \beta x[n-1] \tag{8}$$