Oppenheimer Assignment 1

Sumanth N R

Contents

***Abstract*—Oppenheim and Schafer Discrete Time Signal Processing Prentise Hall 2nd Edition, Solution for Question 3.42(a)**

1 Question 3.42(a)

A casual and stable LTI system $\mathcal{S}$ has its input $x[n]$ and output $y[n]$ related by the linear constant-cofficient difference equation

$$y[n] + \sum_{k=1}^{10} a_k y[n-k] = x[n] + \beta x[n-1] \tag{1.1}$$

Let the impulse response of $\mathcal{S}$ be $h[n]$
Show that $h[0]$ must be non zero

2 Solution

Substituing $x[n] = \delta[n]$, we get $y[n] = h[n]$.
(Since $h[n]$ is the response of $\delta[n]$ to $\mathcal{S}$)

$$\implies h[n] + \sum_{k=1}^{10} a_k h[n-k] = \delta[n] + \beta\delta[n-1] \tag{2.1}$$

Since the system is causal, we have,

$$h[n] = 0 \quad \forall\ n < 0 \tag{2.2}$$

Using (2.2) and substituting $n = 0$ in (2.1), we have,

$$h[0] + \sum_{k=1}^{10} a_k h[-k] = \delta[0] + \beta\delta[-1]$$
$$\implies h[0] = \delta[0] = 1 \tag{2.3}$$

Thus using (2.3), we can conclude that $h[0]$ is equal to 1 and is hence non zero.