Assignment 2

EE3900 - Linear Systems and Signal Processing

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Discrete-time Signal Processing

Oppenheim and Schafer

Problem 2.21(a) Consider an arbitrary linear system with input x[n] and output y[n]. Show that if x[n] = 0 for all n, then y[n] must also be zero for all n.

Solution: For an arbitrary linear system,

$$y[n] = T\{x[n]\}, \tag{1}$$

Let x[n] = 0 for all n.

$$y[n] = T\{x[n]\} \tag{2}$$

For some arbitrary x_1[n], we have

$$y_1[n] = T\{x_1[n]\} \tag{3}$$

Using the linearity of the system:

$$T\{x[n] + x_1[n]\} = T\{x[n]\} + T\{x_1[n]\} \tag{4}$$

$$= y[n] + y_1[n] \tag{5}$$

Since x_1[n] is zero for all n,

$$T\{x[n] + x_1[n]\} = T\{x[n]\} = y_1[n] \tag{6}$$

Hence, y[n] must also be zero for all n.