



## PROBLEM:

Suppose that three systems are hooked together in “cascade.” In other words, the output of  $\mathcal{S}_1$  is the input to  $\mathcal{S}_2$ , and the output of  $\mathcal{S}_2$  is the input to  $\mathcal{S}_3$ . The three systems are specified as follows:

$$\mathcal{S}_1 : \quad y_1[n] = 3x_1[n] - 3x_1[n - 1]$$

$$\mathcal{S}_2 : \quad y_2[n] = 2x_2[n] + 2x_2[n - 2]$$

$$\mathcal{S}_3 : \quad y_3[n] = x_3[n - 1] + x_3[n - 2]$$

NOTE: the output of  $\mathcal{S}_i$  is  $y_i[n]$  and the input is  $x_i[n]$ .

Determine the equivalent system that is a single operation from the input  $x[n]$  (into  $\mathcal{S}_1$ ) to the output  $y[n]$  which is the output of  $\mathcal{S}_3$ . Thus  $x[n]$  is  $x_1[n]$  and  $y[n]$  is  $y_3[n]$ .

(a) Determine the  $z$ -transform system function  $H_i(z)$  for each system.

(b) Write *one difference equation* that defines the overall system in terms of  $x[n]$  and  $y[n]$  only.