PROBLEM:

The diagram in Fig. 1 depicts a *cascade connection* of two linear time-invariant systems; i.e., the output of the first system is the input to the second system, and the overall output is the output of the second system.
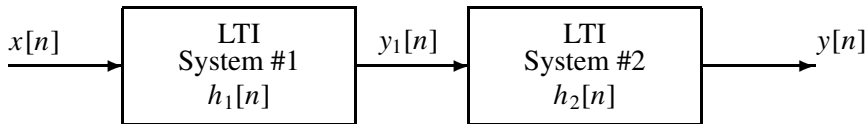

Figure 1: Cascade connection of two LTI systems.

(a) Suppose that System #1 is a blurring filter described by the impulse response:

$$h_1[n] = \begin{cases} 0 & n < 0 \\ \alpha^n & n = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 \\ 0 & n \geq 10 \end{cases}$$

and System #2 is described by the difference equation

$$y_2[n] = y_1[n] - \alpha y_1[n-1]$$

Determine the impulse response function of the overall cascade system.

(b) Obtain a single difference equation that relates $y[n]$ to $x[n]$ in Fig. 1.