Solutions to EE3210 Tutorial 7 Problems

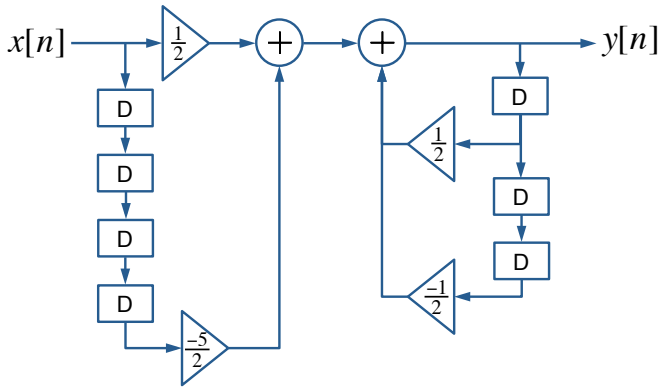
Problem 1: Rearranging

$$2y[n] - y[n-1] + y[n-3] = x[n] - 5x[n-4]$$

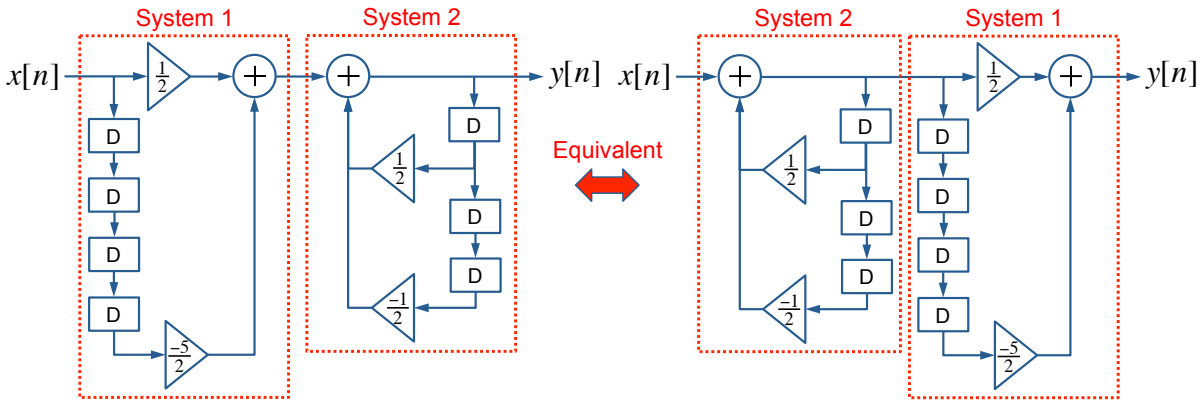
we have

$$y[n] = \frac{1}{2}y[n-1] - \frac{1}{2}y[n-3] + \frac{1}{2}x[n] - \frac{5}{2}x[n-4].$$

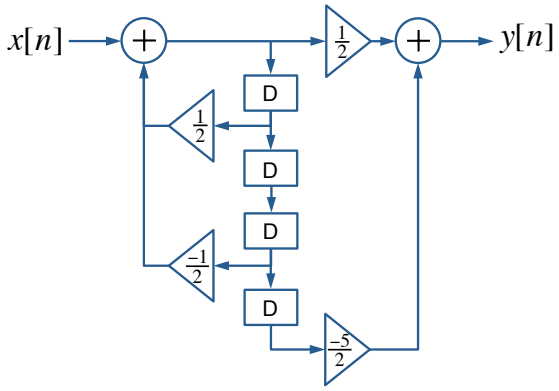
(a) The direct form I realization of the system is



(b) The impulse response of a series interconnection of two LTI systems is independent of the order in which they are cascaded. Thus, we have



and hence the direct form II realization of the system is



Problem 2: Rearranging

$$a_1 \frac{dy(t)}{dt} + a_0 y(t) = b_0 x(t) + b_1 \frac{dx(t)}{dt}$$

we have

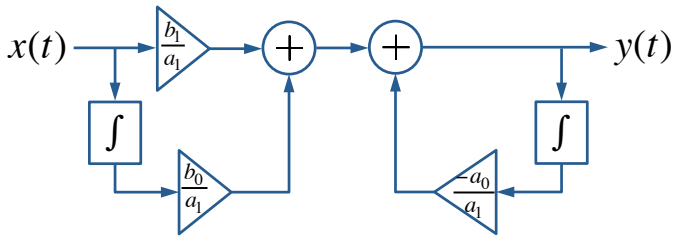
$$\frac{dy(t)}{dt} = -\frac{a_0}{a_1} y(t) + \frac{b_0}{a_1} x(t) + \frac{b_1}{a_1} \frac{dx(t)}{dt}. \tag{1}$$

Integrating both sides of (1), we have

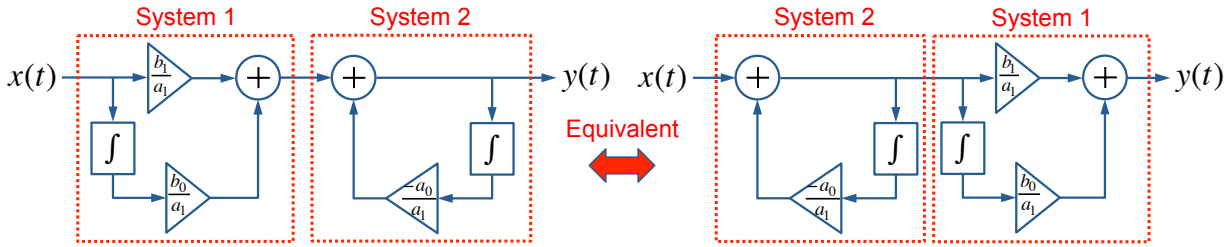
$$y(t) = -\frac{a_0}{a_1} \int_{-\infty}^{t} y(\tau) d\tau + \frac{b_0}{a_1} \int_{-\infty}^{t} x(\tau) d\tau + \frac{b_1}{a_1} x(t)$$

with the assumption of $y(-\infty) = 0$ and $x(-\infty) = 0$.

(a) The direct form I realization of the system is:



(b) The impulse response of a series interconnection of two LTI systems is independent of the order in which they are cascaded. Thus, we have



and hence the direct form II realization of the system is