

Example 4.2: Consider the LTI system with an input-output LCCDE we considered in Example 3.8:

$$\frac{1}{2} \frac{d^4 y(t)}{dt^4} + y(t) = -3 \frac{d^2 x(t)}{dt^2} + 2x(t)$$

Draw a Direct Form II implementation.

Solution:

Using  $m = n = 4$ , we identify

$$\begin{aligned} a_0 &= \frac{1}{2}, \quad a_1 = a_2 = a_3 = 0, \quad a_4 = 1, \\ b_0 &= b_1 = 0, \quad b_2 = -3, \quad b_3 = 0, \quad b_4 = 2. \end{aligned} \tag{E1}$$

Referring to Fig. 8 in the class notes, the multipliers that appear in DFII are

$$\begin{aligned} -\frac{a_1}{a_0} &= -\frac{a_2}{a_0} = -\frac{a_3}{a_0} = 0, \quad -\frac{a_4}{a_0} = -2, \\ \frac{b_0}{a_0} &= \frac{b_1}{a_0} = 0, \quad \frac{b_2}{a_0} = -6, \quad \frac{b_3}{a_0} = 0, \quad \frac{b_4}{a_0} = 4. \end{aligned} \tag{E2}$$

So, we specialize Fig. 8 in the class notes to find the following DFII implementation.

