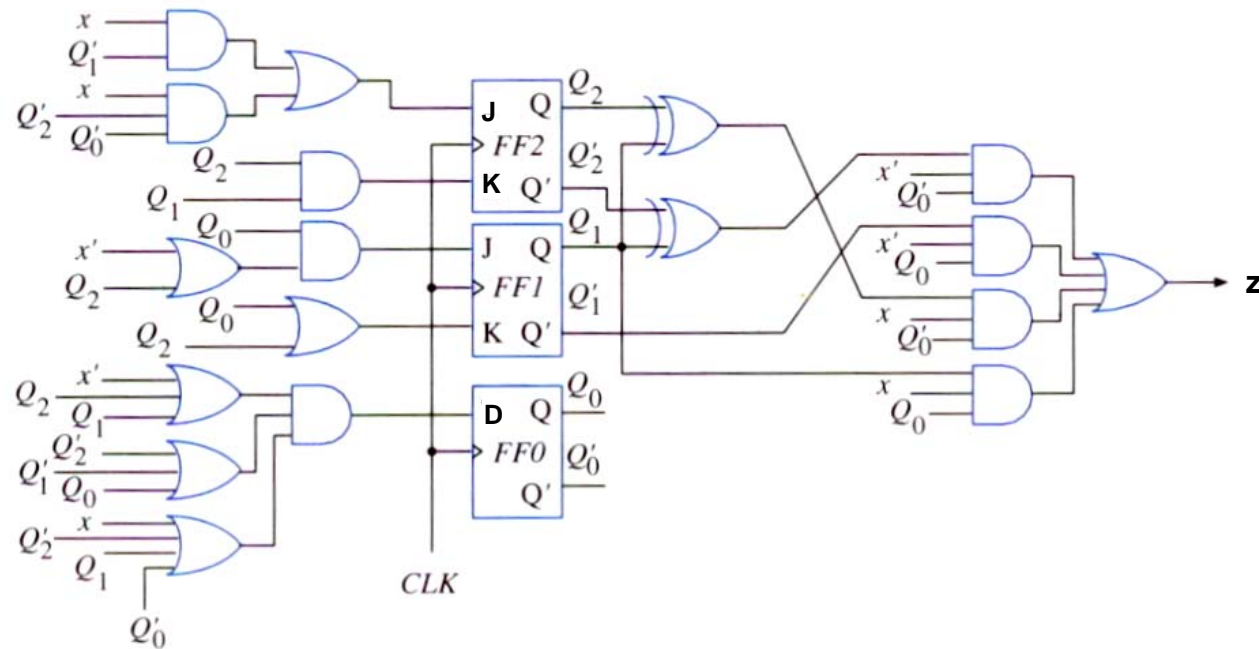


Homework-2

Topic-1

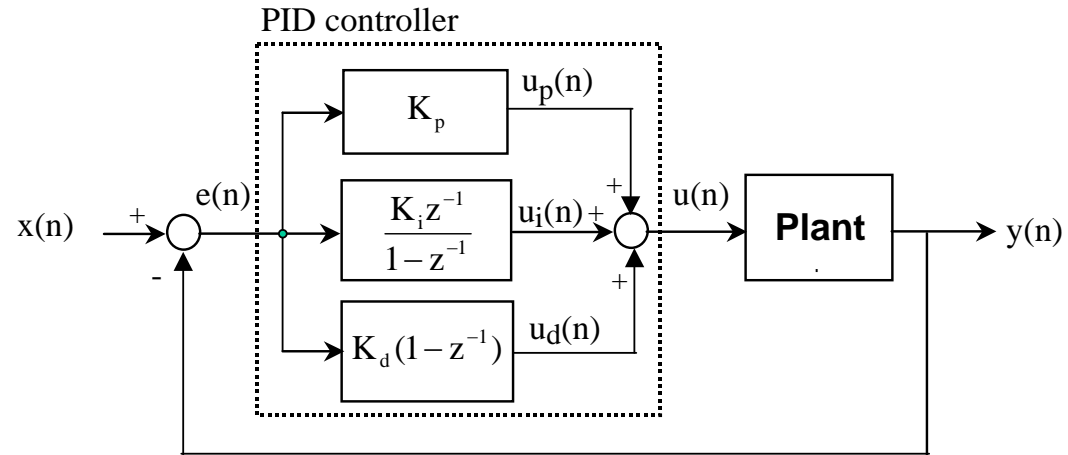
Use the T-FF instead of the JK-FF to redesign the following sequential network. And simulate this two sequential networks in Quartus II to prove that your designed circuit is correct.



Homework-2

Topic-2

Design a PID controller for a specific plant to obtain a good output response of y using Matlab software. Then simulate this close loop control system in Quartus II, then compare the results between them.



Plant:
$$G(z^{-1}) = \frac{Y(z^{-1})}{X(z^{-1})} = \frac{a_0 + a_1 z^{-1} + a_2 z^{-2}}{1 + b_1 z^{-1} + b_2 z^{-2}}$$

$$a_0 = 0.002575, a_1 = 0.00485, a_2 = 0.002575, \\ b_1 = -1.895, b_2 = 0.905$$

PID controller:
$$\frac{U(z^{-1})}{E(z^{-1})} = K_p + \frac{K_i z^{-1}}{1 - z^{-1}} + K_d(1 - z^{-1})$$

or
$$u_p(n) = K_p e(n) \quad u_d(n) = K_d(e(n) - e(n-1))$$

$$u_i(n) = u_i(n-1) + K_i e(n-1)$$

$$u(n) = u_p(n) + u_i(n) + u_d(n)$$

$$= u_i(n-1) + K_p e(n) + K_i e(n-1) + K_d(e(n) - e(n-1))$$

Command error:
$$e(n) = x(n) - y(n)$$