$$
\begin{aligned}
&(Ms^2 + Cs + K)X(s) = bU(s)\\
&Y(s) = dX(s)\\
&U(s) = k_p E(s) + \frac{k_i}{s} E(s) + k_d s E(s)\\
&E(s) = R(s) - e^{-\tau s} dX(s)
\end{aligned}
$$

Considerando:

$V(s) = q(s)R(s)$, com $q(s) = \left(k_p + \frac{k_i}{s} + k_d s\right)$

$$
\begin{aligned}
&U(s) = -\left(k_p + \frac{k_i}{s} + k_d s\right) e^{-\tau s} dX(s) + V(s)\\
&(Ms^2 + Cs + K + e^{-\tau s} q(s) bd) X(s) = V(s)
\end{aligned}
$$

$$
X(s) = (Ms^2 + Cs + K + e^{-\tau s} q(s) bd)^{-1} V(s)
$$

Por Sherman-Morrison:

$$
(Ms^2 + Cs + K + e^{-\tau s} q(s) bD)^{-1} = (H^{-1}(s) + q(s) bD)^{-1} = H(s) - \frac{e^{-\tau s} q(s) H(s) bdH(s)}{1 + e^{-\tau s} q\,(s) dH(s) b}
$$