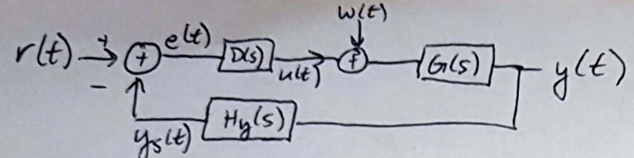
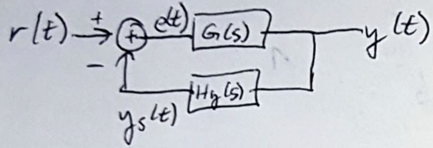
③



$w(t)=0,\ D(s)=1$



$$\frac{Y(s)}{R(s)} = \frac{G(s)}{1+G(s)H_y(s)}$$

a) $$\frac{Y(s)}{R(s)} = \left(\frac{1}{(s+1)(s+4)}\right)\frac{1}{1+\frac{1}{(s+1)(s+4)}} = \frac{1}{(s+1)(s+4)+1}$$

$$\boxed{\frac{Y(s)}{R(s)} = \frac{1}{s^2+5s+5}}$$

has Real poles, $s_{p1} > s_{p2}$

$$\frac{Y(s)}{R(s)} = \frac{1}{(s-s_{p1})(s-s_{p2})} = \frac{A}{s-s_{p1}} + \frac{B}{s-s_{p2}}$$

$$\frac{1}{s_{p1}-s_{p2}} = A \qquad \frac{1}{s_{p2}-s_{p1}} = B = -A$$

$$\frac{Y(s)}{R(s)} = \frac{\left(\frac{1}{s_{p1}-s_{p2}}\right)}{s-s_{p1}} - \frac{\left(\frac{1}{s_{p1}-s_{p2}}\right)}{s-s_{p2}}$$

$$h(t) = \frac{1}{s_{p1}-s_{p2}} e^{+s_{p1}t} u(t) - \frac{1}{s_{p1}-s_{p2}} e^{+s_{p2}t} u(t)$$

$$s_{p1,2} = \frac{-5 \pm \sqrt{25-20}}{2} = \frac{-5+\sqrt{5}}{2},\ \frac{-5-\sqrt{5}}{2}$$

$$s_{p1} - s_{p2} = \sqrt{5}$$

$$\boxed{h(t) = \left(\frac{1}{\sqrt{5}} e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} - \frac{1}{\sqrt{5}} e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\right) u(t)}$$

b) $$\frac{Y(s)}{R(s)} = \frac{\frac{1}{s+4}}{1+\left(\frac{1}{s+1}\right)\left(\frac{1}{s+4}\right)} = \boxed{\frac{s+1}{s^2+5s+5}}$$

$$\frac{Y(s)}{R(s)} = \frac{s}{s^2+5s+5} + \frac{1}{s^2+5s+5}$$

$$h(t) = \frac{d}{dt}\left[\frac{1}{\sqrt{5}}\left(e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} - e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\right)u(t)\right] + \frac{1}{\sqrt{5}}\left[e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} - e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\right)u(t)\Big]$$

$$h(t) = \frac{1}{\sqrt{5}}\Big[\cancel{\delta(t) - \delta(t)} + -\left(\frac{5-\sqrt{5}}{2}\right)e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} + \left(\frac{5+\sqrt{5}}{2}\right)e^{-\left(\frac{5+\sqrt{5}}{2}\right)t} + e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} - e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\Big]u(t)$$

$$\boxed{h(t) = \frac{1}{\sqrt{5}} u(t)\left[\frac{\cancel{7}^{\,3}-\sqrt{5}}{2} e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} + \frac{\cancel{7}^{\,3}+\sqrt{5}}{2} e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\right]}$$

corrected solution as of 12/13/2016

$$\boxed{h(t) = \frac{1}{\sqrt{5}} u(t)\left[\frac{-3-\sqrt{5}}{2} e^{-\left(\frac{5-\sqrt{5}}{2}\right)t} + \frac{3+\sqrt{5}}{2} e^{-\left(\frac{5+\sqrt{5}}{2}\right)t}\right]}$$