

# HW 10

3.24

$$(b) \quad x_2(t) = 2u(t) \Rightarrow Y_2(s) = \frac{2}{s^2}$$

$$Y_2(s) = H(s) Y_2(s) = \frac{36s+20}{s^2(s+1)(s+5)}$$

$$Y_2(s) = \frac{B_1}{s} + \frac{B_2}{s^2} + \frac{A_1}{s+1} + \frac{A_2}{s+5}$$

$$B_2 = s^2 Y_2(s) |_{s=0} = \underline{4}$$

$$B_1 = \frac{d}{ds} s^2 Y_2(s) |_{s=0} = \underline{2.4}$$

$$A_1 = (s+1) Y_2(s) |_{s=-1} = \underline{-4}$$

$$A_2 = (s+5) Y_2(s) |_{s=-5} = \underline{1.6}$$

$$Y_2(s) = \frac{2.4}{s} + \frac{4}{s^2} = \frac{4}{s+1} + \frac{1.6}{s+5}$$

$$y_2(t) = [2.4 + 4t - 4e^{-t} + 1.6e^{-5t}] u(t)$$

(c)

$$x_3(t) = 2e^{-4t} u(t) \Rightarrow X_3(s) = \frac{2}{s+4}$$

$$Y_3(s) = H(s) X_3(s) = \frac{36s+26}{(s+1)(s+4)(s+5)}$$

$$A_1 = (s+1)Y_3(s)|_{s=-1} = -\frac{4}{3}$$

$$A_2 = (s+4)Y_3(s)|_{s=-4} = \frac{124}{3}$$

$$A_3 = (s+5)Y_3(s)|_{s=-5} = -40$$

$$Y_3(s) = \frac{-4}{3(s+1)} + \frac{124}{3(s+4)} = \frac{40}{s+5}$$

$$y_3(t) = \left[ -\frac{4}{3} e^{-t} + \frac{124}{3} e^{-4t} - 40 e^{-5t} \right] u(t)$$

$$(d) \quad x_4(t) = [4 \cos 4t] u(t) \Rightarrow x_4(s) = \frac{4s}{s^2 + 16}$$

$$Y_4(s) = H(s) x_4(s) = \frac{4s(19s + 10)}{(s+1)(s+5)(s+j4)(s-j4)}$$

$$A_1 = (s+1) Y_4(s) |_{s=-1} = \frac{8}{17}$$

$$A_2 = (s+5) Y_4(s) |_{s=-5} = -\frac{400}{41}$$

$$B = (s+j4) Y_4(s) |_{s=-j4} = 5.51 e^{j32.5^\circ}$$

so

$$Y_4(s) = \frac{8}{17(s+1)} + \frac{400}{41(s+5)} + \frac{5.51 e^{j32.5^\circ}}{s+j4} + \frac{5.51 e^{-j32.5^\circ}}{s-j4}$$

$$y_4(t) = \left[ \frac{8}{17} e^{-t} - \frac{400}{41} e^{-5t} + 11.02 \cos(4t - 32.5^\circ) \right] u(t)$$

3.25 (a)

$$Y(s) = \frac{s}{s} - \frac{10}{s^2} + \frac{40}{s^2+4}$$

$$X(s) = \frac{1}{s}$$

$$H(s) = \frac{Y(s)}{X(s)}$$

$$H(s) = \frac{s}{s} - \frac{10}{s^2} + \frac{40s}{s^2+4} = \frac{s(s^3 + 6s^2 + 4s - 8)}{s(s^2+4)}$$

$$(b) \quad H(s) = s - \frac{10}{s} + \frac{40s}{s^2+4}$$

$$h(t) = s \delta(t) - 10[1 - 4 \cos 2t]u(t)$$