3.13a) $X(s) = \dfrac{6}{(s+2)(s+4)} = \dfrac{C_1}{s+2} + \dfrac{C_2}{s+4}$

$C_1 = \dfrac{6}{s+4}$ $s = -2$, $\Rightarrow \dfrac{6}{-2+4} = \dfrac{6}{2} = 3$

$C_2 = \dfrac{6}{s+2}$ $s = -4$, $\Rightarrow \dfrac{6}{-4+2} = \dfrac{6}{-2} = -3$

$X(s) = \dfrac{3}{s+2} - \dfrac{3}{s+4}$

$$\boxed{x(t) = 3e^{-2t}u(t) - 3e^{-4t}u(t)}$$

3.13c) $X(s) = \dfrac{3s^3 + 36s^2 + 131s + 144}{s(s+4)\boxed{(s^2 + 6s + 9)}} \longrightarrow = (s+3)(s+3)$

$X(s) = \dfrac{3s^3 + 36s^2 + 131s + 144}{s(s+4)(s+3)(s+3)} = \dfrac{C_1}{s} + \dfrac{C_2}{s+4} + \dfrac{C_3}{s+3} + \dfrac{C_4}{s+3}$

$C_1 = \dfrac{3s^3 + 36s^2 + 131s + 144}{(s+4)(s+3)(s+3)}$ $s = 0$ $= \dfrac{0 + 0 + 0 + 144}{(4)(3)(3)}$

$C_1 = \dfrac{144}{36} = 4$

$C_2 = \dfrac{3s^3 + 36s^2 + 131s + 144}{s(s+3)(s+3)}$ $s = -4$ $= \dfrac{\overset{-192}{\overbrace{3(-4)^3}} + \overset{576}{\overbrace{36(-4)^2}} + \overset{-524}{\overbrace{131(-4)}} + 144}{-4\underbrace{(-4+3)}_{-1}\underbrace{(-4+3)}_{-1}}$

$C_2 = \dfrac{4}{-4} = -1$

3.13c)

$$C_3 = \frac{3s^3 + 36s^2 + 131s + 144}{s(s+4)(s+3)} \bigg|_{s=-3} = \frac{3(-3)^3 + 36(-3)^2 + 131(-3) + 144}{-3(-3+4)(-3+3)}$$

3.14 b.) $X_{(s)} = \dfrac{2s^2 + 10s + 16}{(s+2)(s^2 + 6s + 10)}$

$$\Rightarrow \frac{2}{s+2} - \boxed{\frac{2}{s^2 + 6s + 10}} = 2 \cdot \frac{1}{(s+3)^2 + 1}$$

$$\mathcal{L}^{-1}\left\{\frac{2}{s+2}\right\} - 2\,\mathcal{L}^{-1}\left\{\frac{1}{(s+3)^2 + 1}\right\}$$

$$\underbrace{2e^{-2t}u(t)}_{} \qquad \underbrace{e^{-3t}\sin(t)}_{}$$

$$\boxed{x(t) = 2e^{-2t}u(t) - 2e^{-3t}\sin(t)u(t)}$$

3.15 c) $X_{(s)} = \dfrac{\sqrt{2}\,(s+1)}{s^2 + 6s + 13}$

$$s = \frac{-6 \pm \sqrt{6^2 - 4(1)(13)}}{2}$$

$$= -16$$

$$= \frac{-6 \pm 4j}{2} = -3 \pm 2j$$

$$\frac{\sqrt{2}\,(s+1)}{(-3+2j)(-3-2j)}$$

$$\boxed{x(t) = \sqrt{2}\,e^{-3t}\cos(2t)u(t) - \sqrt{2}\,e^{-3t}\sin(2t)u(t)}$$

3.17c.) $X(s) = \dfrac{(s+5)e^{-2s}}{(s+1)(s+3)}$ # Seperate e^{-2s}

$= \dfrac{s+5}{(s+1)(s+3)} = \dfrac{C_1}{s+1} + \dfrac{C_2}{s+3}$

$C_1 = \dfrac{s+5}{s+3} \quad s=-1 \implies \dfrac{(-1)+5}{(-1)+3} = \dfrac{4}{2} = 2$

$C_2 = \dfrac{s+5}{s+1} \quad s=-3 \implies \dfrac{(-3)+5}{(-3)+1} = \dfrac{2}{-2} = -1$

$= 2 \cdot \dfrac{1}{s+1} - 1 \cdot \dfrac{1}{s+3}$

$X_1(t) = 2e^{-t}u(t) - e^{-3t}u(t)$

$x(t) = X_1(t-2)u(t-2)$

$\boxed{x(t) = 2e^{-(t-2)}u(t-2) - e^{-3(t-2)}u(t-2)}$