ECE 1673
HW1 Solutions

B.3. (a) $F(s) = \dfrac{5}{s(s+1)(s+2)} = \dfrac{2.5}{s} + \dfrac{-5}{s+1} + \dfrac{2.5}{s+2}$

$f(t) = 2.5 - 5e^{-t} + 2.5e^{-2t}$

(b) $F(s) = \dfrac{1}{s^2(s+1)} = \dfrac{1}{s^2} + \dfrac{-1}{s} + \dfrac{1}{s+1}$

$f(t) = t - 1 + e^{-t}$

(c) $F(s) = \dfrac{2s+1}{s^2+2s+10} = \dfrac{2s+1}{(s+1)^2+3^2} = \dfrac{2(s+1)}{(s+1)^2+3^2} + \dfrac{-1}{(s+1)^2+3^2}$

$f(t) = 2e^{-t}\cos 3t - \frac{1}{3}e^{-t}\sin 3t$

(d) $F(s) = \dfrac{s-30}{s(s^2+4s+29)} = \dfrac{s-30}{s[(s+2)^2+5^2]} = \dfrac{-\frac{30}{29}}{s} + \dfrac{k_2(s+2)+5k_3}{(s+2)^2+5^2}$

$k_2 = 30/29,\ \ k_3 = 89/145$

$$f(t) = -\frac{30}{29} + \frac{30}{29}e^{-2t}\cos(5t) + \frac{89}{145}e^{-2t}\sin(5t).$$

B.6. (a) $f(t) = 4e^{-2(t-3)}$; $df/dt = 4e^{-2(t-3)}(-2) = -8e^{-2(t-3)}$

$= -8e^{6}e^{-2t} = -8(403.4)e^{-2t} = -3{,}227.4e^{-2t}$

$\therefore \mathcal{L}[df/dt] = \dfrac{-3227}{s+2}$

(b) $\mathcal{L}[df/dt] = sF(s) - f(0^+) = s\mathcal{L}[4e^{6}e^{-2t}] - 4e^{6}$

$= \dfrac{1{,}613}{s+2} - 1{,}613 = \dfrac{-3227}{s+2}$

(c) $f(t) = 4e^{-2(t-3)}u(t-3)$

$df/dt = -8e^{-2(t-3)}u(t-3) + 4e^{-2(t-3)}\big|_{t=3}\delta(t-3)$

$\mathcal{L}[df/dt] = \dfrac{-8e^{-3s}}{s+2} + 4e^{-3s} = \dfrac{4se^{-3s}}{s+2}$

(d) $\mathcal{L}[df/dt] = sF(s) - f(0) = sF(s) = \dfrac{4se^{-3s}}{s+2}$

2.13. (a) Fig. (a) $C = G_1G_2E$ $\qquad F = G_1HE$

Fig. (b) $C = G_aE$ $\qquad F = G_aG_bE$

$\therefore G_a = G_1G_2$ $\qquad G_b = \dfrac{G_1H}{G_a} = \dfrac{H}{G_2}$

(b) Fig. (c) $C = G_cG_dE$ $\qquad F = G_cE$

$\therefore G_c = G_1H$ $\qquad G_d = \dfrac{G_1G_2}{G_c} = \dfrac{G_2}{H}$

2.12. (a) Fig.(a) $C = G_1 G_2 E + G_2 H F$

Fig.(b) $C = G_a E + G_a G_b F$

$\therefore G_a = G_1 G_2$ and $G_b = \dfrac{G_2 H}{G_a} = \dfrac{H}{G_1}$.

(b) Fig. (c) $C = G_c E + G_d F$

$\therefore G_c = \underline{G_1 G_2}$ and $G_d = \underline{G_2 H}$