S13: (10 points)

[a]

$$F(s) = \begin{array}{r|r} & 10 \\ \hline s^2+6s+5 & 10s^2+85s+95 \\ & 10s^2+60s+50 \\ \cline{2-2} & 25s+45 \end{array}$$

$$F(s) = 10 + \frac{25s+45}{s^2+6s+5} = 10 + \frac{K_1}{s+1} + \frac{K_2}{s+5}$$

$$K_1 = \left.\frac{25s+45}{s+5}\right|_{s=-1} = 5$$

$$K_2 = \left.\frac{25s+45}{s+1}\right|_{s=-5} = 20$$

$$F(s) = 10 + \frac{5}{s+1} + \frac{20}{s+5}$$

$$f(t) = 10\delta(t) + [5e^{-t} + 20e^{-5t}]u(t)$$

[b]

$$F(s) = \begin{array}{r|r} & 5 \\ \hline s^2+4s+5 & 5s^2+40s+25 \\ & 5s^2+20s+25 \\ \cline{2-2} & 20s \end{array}$$

$$F(s) = 5 + \frac{20s}{s^2+4s+5} = 5 + \frac{K_1}{s+2-j} + \frac{K_1^*}{s+2+j}$$

$$K_1 = \left.\frac{20s}{s+2+j}\right|_{s=-2+j} = 10 + j20 = 22.36\underline{/63.43^\circ}$$

$$F(s) = 5 + \frac{22.36\underline{/63.43^\circ}}{s+2-j} + \frac{22.36\underline{/-63.43^\circ}}{s+2+j}$$

$$f(t) = 5\delta(t) + 44.72e^{-2t}\cos(t+63.43^\circ)u(t)$$

S14: (10 points)

[a] $$I_{dc} = \frac{1}{L}\int_0^t v_o\,dx + \frac{v_o}{R} + C\frac{dv_o}{dt}$$

[b] $$\frac{I_{dc}}{s} = \frac{V_o(s)}{sL} + \frac{V_o(s)}{R} + sCV_o(s)$$

$$\therefore \quad V_o(s) = \frac{I_{dc}/C}{s^2 + (1/RC)s + (1/LC)}$$

[c] $$i_o = C\frac{dv_o}{dt}$$

$$\therefore \quad I_o(s) = sCV_o(s) = \frac{sI_{dc}}{s^2 + (1/RC)s + (1/LC)}$$

S15: (10 points)

[a] $$\frac{1}{L}\int_0^t v_1\,d\tau + \frac{v_1 - v_2}{R} = i_g$$

and

$$C\frac{dv_2}{dt} + \frac{v_2}{R} - \frac{v_1}{R} = 0$$

[b] $\dfrac{V_1}{sL} + \dfrac{V_1 - V_2}{R} = I_g$

$$\frac{V_2 - V_1}{R} + sCV_2 = 0$$

or

$$(R + sL)V_1(s) - sLV_2(s) = RLsI_g(s)$$

$$-V_1(s) + (RCs + 1)V_2(s) = 0$$

Solving,

$$V_2(s) = \frac{sI_g(s)}{C[s^2 + (R/L)s + (1/LC)]}$$