14.14 Use loop equations to find $i_o(t)$, $t > 0$, in the network shown in Fig. P14.14.

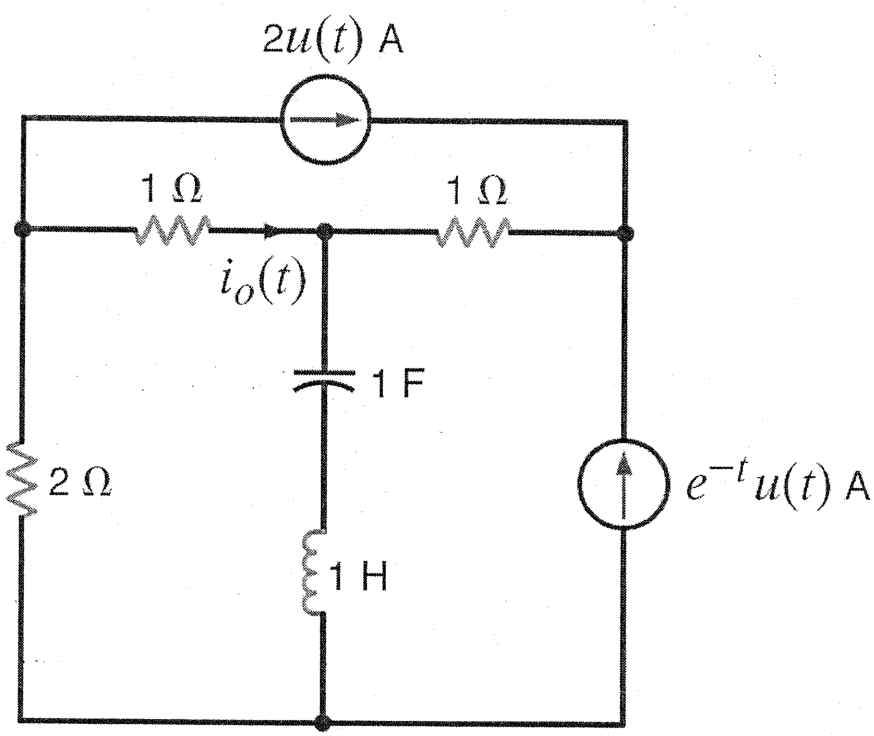
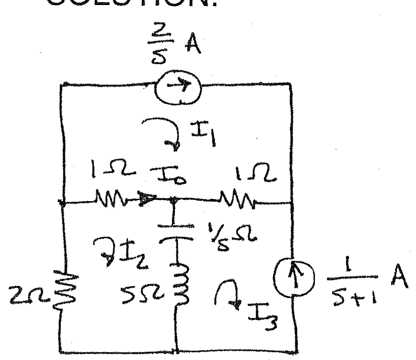


Figure P14.14

SOLUTION:



$$I_1 = \frac{2}{s}\,A \quad \& \quad I_3 = \frac{-1}{s+1}\,A$$

$$I_2\left(s + 3 + 1/s\right) - I_1(1) - I_3\left(s + \frac{1}{s}\right) = 0$$

$$\text{or, } I_2\left(s^2 + 3s + 1\right) = sI_1 + \left(s^2+1\right)I_3$$

$$I_2\left(s^2+3s+1\right) = 2 - \frac{s^2+1}{s+1} = \frac{-s^2+2s+1}{s+1}$$

$$I_2 = \frac{-s^2+2s+1}{\left(s^2+3s+1\right)(s+1)}$$

$$I_o = I_2 - I_1 = \frac{-s^2+2s+1}{s^2+3s+1} - \frac{2}{s} = \frac{-\left(3s^3+6s^2+7s+2\right)}{s(s+1)\left(s^2+3s+1\right)}$$

$$I_o(s) = \frac{-\left(3s^3+6s^2+7s+2\right)}{s(s+1)(s+0.382)(s+2.62)} = \frac{K_1}{s} + \frac{K_2}{s+1} + \frac{K_3}{s+0.382} + \frac{K_4}{s+2.62}$$

$$K_1 = \frac{-2}{(1)(1)} = -2$$

$$K_2 = \frac{-(-3+6-7+2)}{(-1)(1-3+1)} = 2$$

$$K_3 = \left.\frac{-(3s^3+6s^2+7s+2)}{s(s+1)(s+2.62)}\right|_{s=-0.382} = 0.065$$

$$K_4 = \left.\frac{-(3s^2+6s^2+7s+2)}{s(s+1)(s+0.382)}\right|_{s=2.62} = -3.065$$

$$i_o(t) = \left[2 + 2e^{-t} + 0.065e^{-0.382t} - 3.065e^{-2.62t}\right]u(t)$$