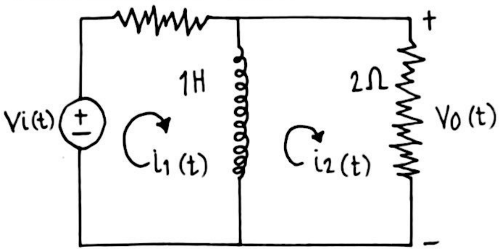
LABORATORY NO. 3
GROUP 2

PROBLEM NO. 3 FIG. A



KVL @ loop $i_1(t)$

$$V_i(t) = R_1 i_1(t) + L\frac{di_1(t)}{d(t)} - L\frac{di_2(t)}{d(t)}$$

$$\mathcal{L}\{V_i(t) = i_1(t) + \frac{di_1(t)}{d(t)} - \frac{di_2(t)}{d(t)}\}$$

$$V_i(s) = I_1(s) + sI_1(s) - sI_2(s)$$

$$V_i(s) = I_1(s)[s+1] - sI_2(s) \quad (1)$$

KVL @ loop $i_2(t)$

$$0 = L\frac{di_2(t)}{d(t)} - R_2 i_2(t) - L\frac{di_1(t)}{d(t)}$$

$$\mathcal{L}\{0 = \frac{di_2(t)}{d(t)} + 2i_2(t) - \frac{di_1(t)}{d(t)}\}$$

$$0 = sI_2(s) + 2I_2(s) - sI_1(s)$$

$$0 = I_2(s)[s+2] - sI_1(s) \quad (2)$$

$$I_2(s) = \frac{\begin{bmatrix} s+1 & V_i(s) \\ -s & 0 \end{bmatrix}}{\begin{bmatrix} s+1 & -s \\ -s & s+2 \end{bmatrix}} = \frac{0-[-sV_i(s)]}{(s+1)(s+2)-s^2}$$

$$I_2(s) = \frac{sV_i(s)}{\cancel{s^2} + 2s + 1s + 2 \cancel{-s^2}}$$

$$\frac{I_2(s)}{V_i(s)} = \frac{s}{3s+2}$$

$$V_{R2}(s) = R_2 I(s)$$

$$V_{R2}(s) = 2I(s)$$

$$I(s) = \frac{V_{R2}(s)}{2}$$

$$2\left[\frac{V_{R2}(s)}{2V_i(s)} = \frac{s}{3s+2}\right]2$$

$$\frac{V_{R2}(s)}{V_i(s)} = \frac{2s}{3s+2}$$

$$V_i(s) \rightarrow \boxed{\frac{2s}{3s+2}} \rightarrow V_{R2}(s)$$

FOR $I_1(s)$:

$$I_1(s) = \frac{\begin{bmatrix} V(s) & -s \\ 0 & s+2 \end{bmatrix}}{\begin{bmatrix} 1+s & -s \\ -s & s+2 \end{bmatrix}} = \frac{V(s)}{s+2s+s^2+2s-s^2}$$

$$I_1(s) = \frac{V(s)[s+2]}{3s+2}$$

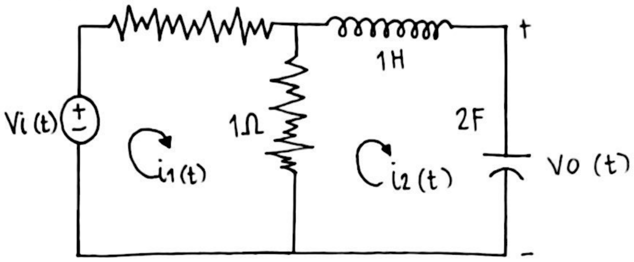
$$\frac{I_1(s)}{V(s)} = \frac{s+2}{3s+2}$$

$$V(s) \rightarrow \boxed{\frac{s+2}{3s+2}} \rightarrow I_1(s)$$

OR

$$V(s) \rightarrow \boxed{\frac{s}{s+2}} \rightarrow I_1(s)$$

FIGURE (b)



KVL@ loop 1

$$\mathcal{L}\{V(t) = R_1 i_1(t) + R_2 i_1(t) - R_2 i_2(t)\}$$

$$V(s) = R_1 I_1(s) + R_2 I_1(s) - R_2 I_2(s)$$

$$\underset{C}{V(s)} = 2\underset{A}{I_1(s)} - \underset{B}{I_2(s)} \quad ①$$

KVL@ loop 2

$$0 = R_2 i_2(t) + L\frac{di_2(t)}{d(t)} + \frac{1}{C}\int i_2(t)\,dt - R_2 i_1(t)$$

$$\mathcal{L}\{0 = i_2(t) + \frac{di_2(t)}{d(t)} + \frac{1}{2}\int i_2(t)\,dt - i_1(t)\}$$

$$0 = I_2(s) + s I_2(s) + {}^1/_{2s}\, I_2(s) - I_1(s)$$

$$\underset{C}{0} = \underset{B}{I_2(s)}\left[\frac{2s+2s^2+1}{2s}\right] - \underset{A}{I_1(s)} \quad ②$$

$$I_2(s) = \frac{\begin{array}{cc} A & C \\ \end{array}\begin{bmatrix} 2 & V(s) \\ -1 & 0 \end{bmatrix}}{\begin{bmatrix} 2 & -1 \\ -1 & \frac{2s+2s^2+1}{2s} \end{bmatrix}\begin{array}{c} \\ A \end{array}} = \frac{0-[-V(s)]}{2\left[\frac{2s+2s^2+1}{2s}\right]-1}$$

$$I_2(s) = \frac{V(s)}{\frac{4s+4s^2+4}{2s} - 1}$$

$$I_2(s) = \frac{V(s)}{\frac{4s+4s^2+2-2s}{2s}}$$

$$\frac{I_2(s)}{V(s)} = \frac{2s}{4s^2+2s+2}$$

$$\frac{V_C(s)}{I(s)} = \frac{1}{Cs}$$

$$\frac{V_C(s)}{I(s)} = \frac{1}{2s}$$

$$2s\,V_C(s) = I(s)$$

$$\frac{1}{\cancel{2s}}\left[\frac{2sV_C(s)}{V(s)} = \frac{2s}{4s^2+2s+2}\right]\frac{1}{\cancel{2s}}$$

$$\frac{V_C(s)}{V(s)} = \frac{1}{4s^2+2s+2}$$

$$V(s) \longrightarrow \boxed{\frac{1}{4s^2+2s+2}} \xrightarrow{\;V_C(s)\;}$$

FOR $I_1(s)$; FIG. B

$$I_1(s) = \frac{\begin{bmatrix} V(s) & -1 \\ 0 & \frac{2s+2s^2+1}{2s} \end{bmatrix}}{\begin{bmatrix} 2 & -1 \\ -1 & \frac{2s+2s^2+1}{2s} \end{bmatrix}} \quad \frac{V(s)\left[\frac{2s+2s^2+1}{2s}\right]}{\frac{4s+4s^2+4}{2s} - 1}$$

$$\frac{I_1(s)}{V(s)} = \frac{\frac{2s^2+2s+1}{2s}}{\frac{4s^2+2s+2}{2s}}$$

$$\frac{I_1(s)}{V(s)} = \frac{2s^2+2s+1}{\cancel{2s}} \cdot \frac{\cancel{2s}}{4s^2+2s+2}$$

$$\frac{I_1(s)}{V(s)} = \frac{2s^2+2s+1}{4s^2+2s+2}$$

$$\frac{I_1(s)}{V(s)} = \frac{2s^2+2s+1}{2[2s^2+s+1]}$$

$$\xrightarrow{V(s)} \boxed{\frac{2s^2+2s+1}{2[2s^2+s+1]}} \xrightarrow{I_1(s)}$$

AND

$$\xrightarrow{V(s)} \boxed{\frac{2s}{4s^2+2s+2}} \xrightarrow{I_2(s)}$$