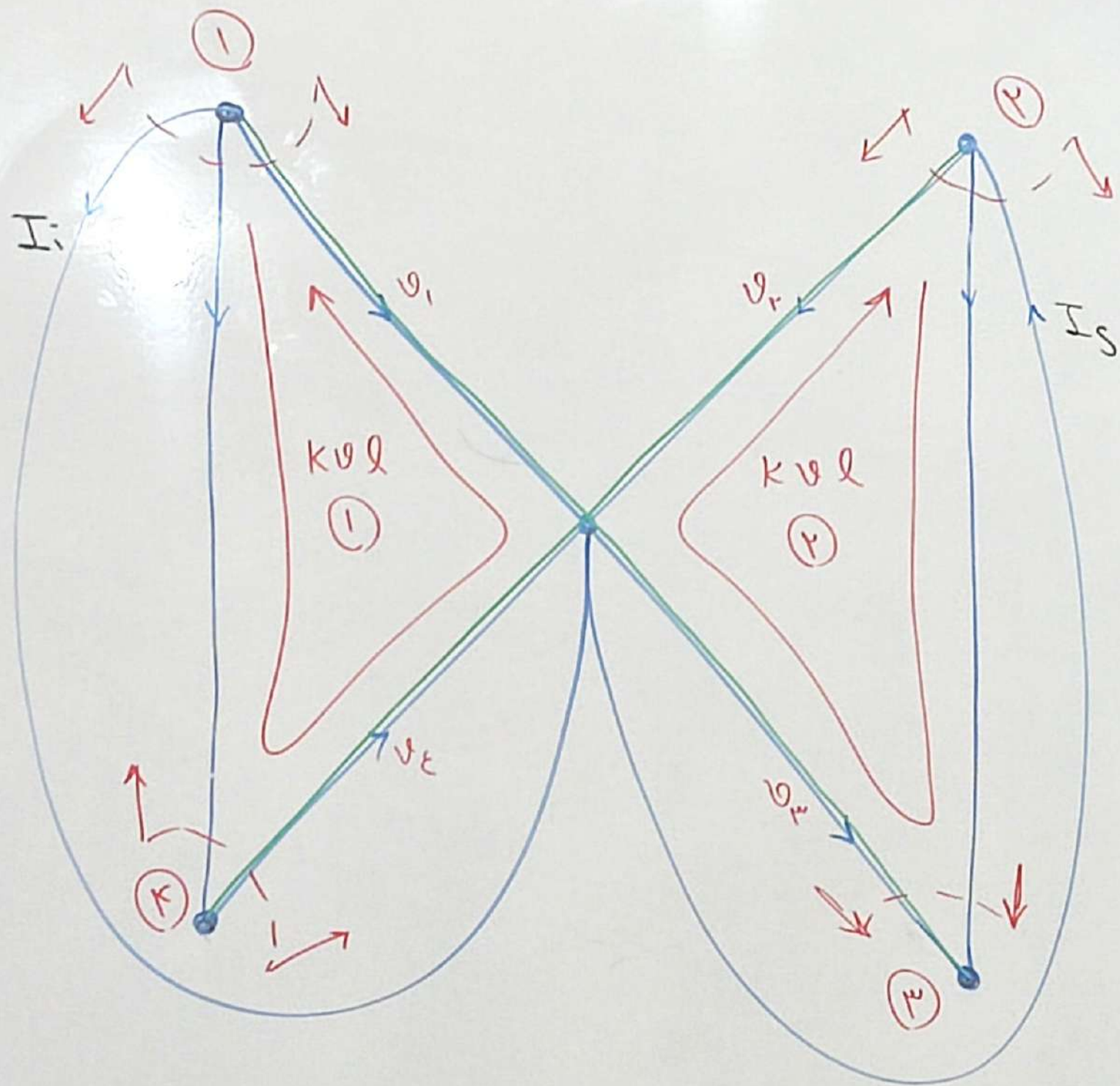




$$\text{KCL } (1) \quad C_1 \frac{dv_1}{dt} + i_1 + I_i = 0$$

$$\frac{dv_1}{dt} = -\frac{1}{C_1} i_1 - \frac{1}{C_1} I_i \quad (1)$$

$$\text{KCL } (2) \quad C_r \frac{dv_r}{dt} + i_r - I_s = 0$$

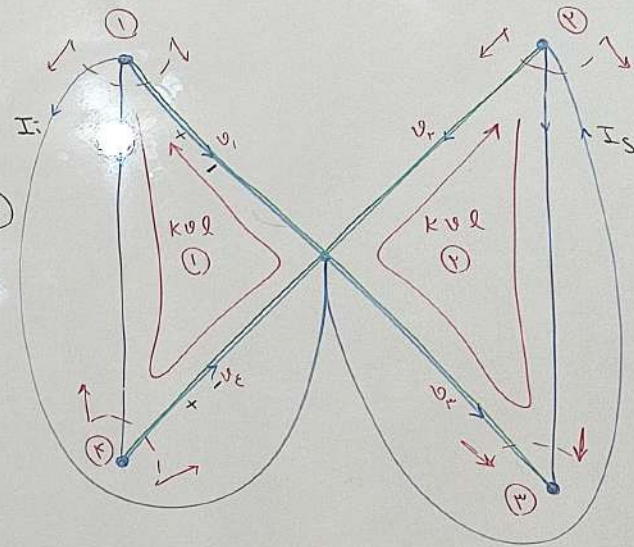
$$\frac{dv_r}{dt} = -\frac{1}{C_r} i_r + \frac{1}{C_r} I_s \quad (2)$$

$$\text{KCL } (3) \quad C_r \frac{dv_r}{dt} + i_r = 0 \Rightarrow \frac{dv_r}{dt} = -\frac{1}{C_r} i_r \quad (3)$$

$$\text{KCL } (4) \quad C_e \frac{dv_e}{dt} - i_1 = 0 \Rightarrow \frac{dv_e}{dt} = \frac{1}{C_e} i_1 \quad (4)$$

$$\text{KVL } (1) \quad L_1 \frac{di_1}{dt} + v_e - v_1 = 0$$

$$\frac{di_1}{dt} = \frac{1}{L_1} v_1 - \frac{1}{L_1} v_e \quad (5)$$



$$KVL \textcircled{r}) \quad L_r \frac{di_r}{dt} - v_\mu - v_r = 0$$

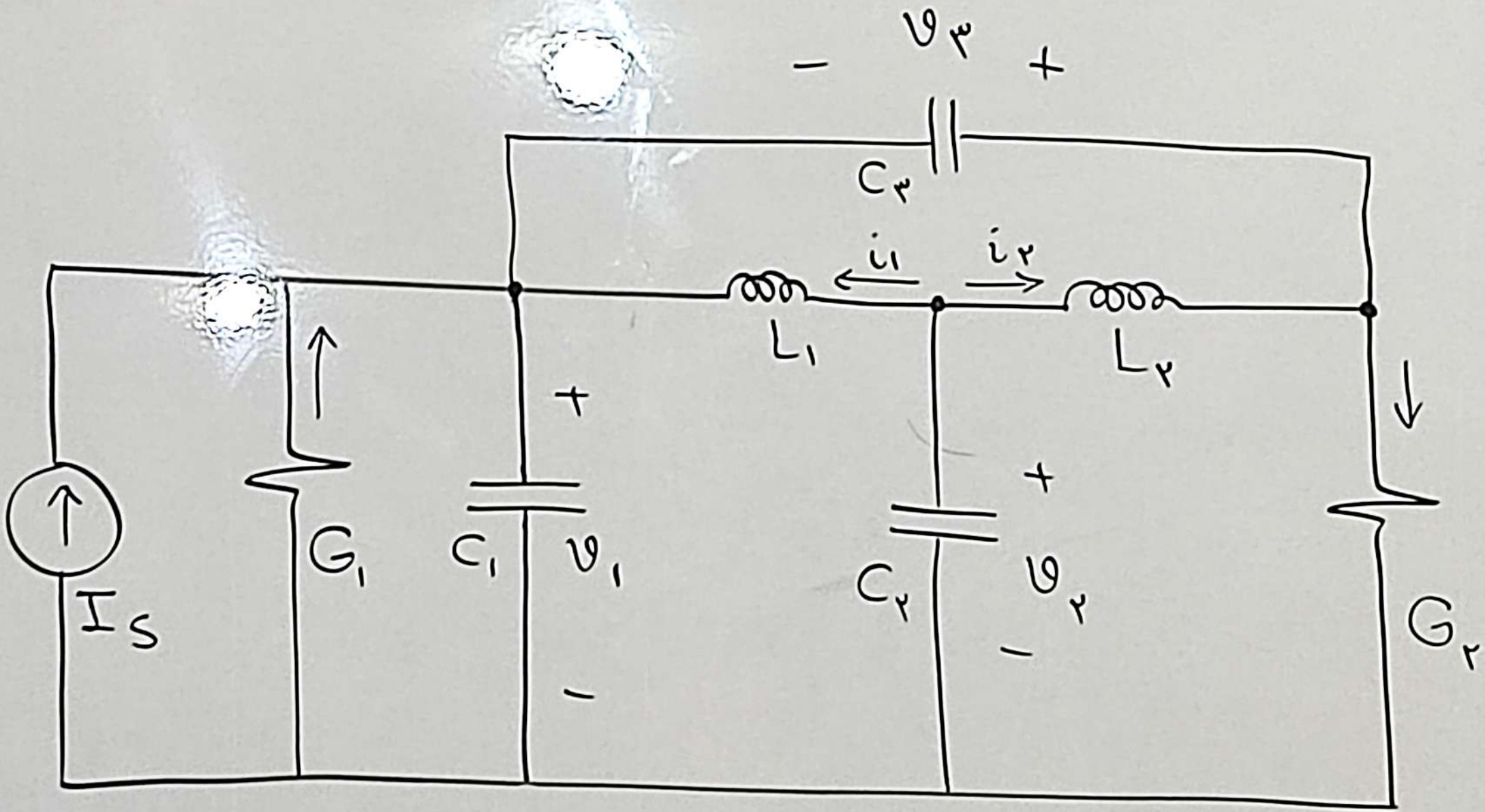
$$\frac{di_r}{dt} = \frac{1}{L_r} v_r + \frac{1}{L_r} v_\mu \quad \textcircled{4}$$

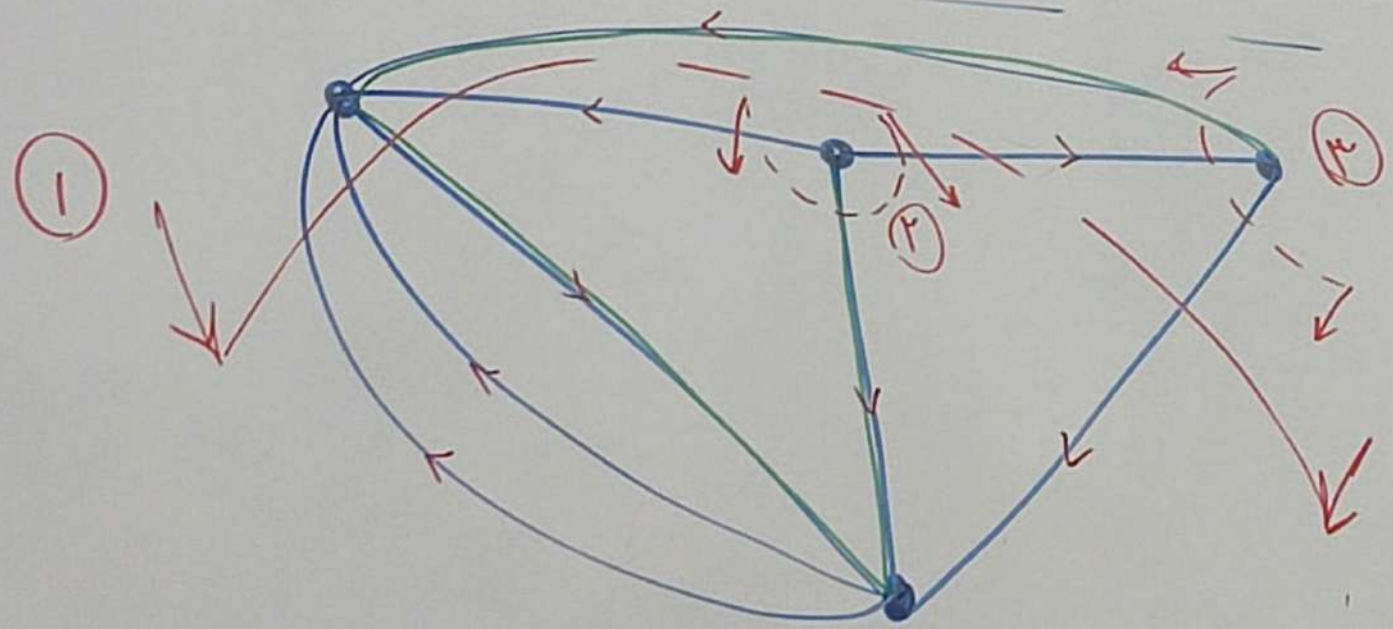
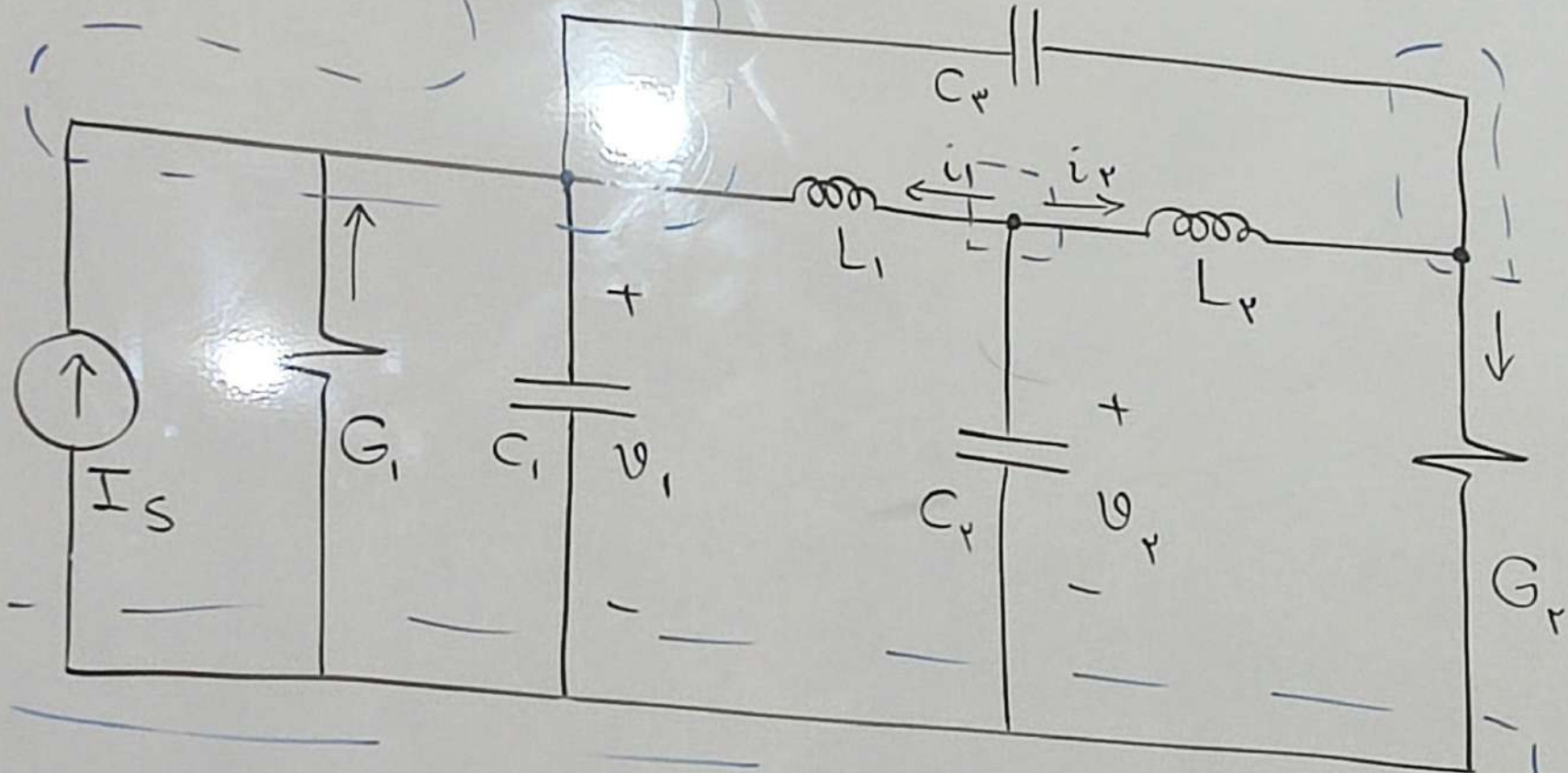
$$\frac{d}{dt} \begin{bmatrix} v_1 \\ v_r \\ v_\Sigma \\ i_1 \\ i_r \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} + \begin{bmatrix} 0 & 0 & -\frac{1}{C_1} & 0 & 0 \\ 0 & 0 & 0 & -\frac{1}{C_r} & 0 \\ 0 & 0 & 0 & -\frac{1}{C_\Sigma} & 0 \\ 0 & -\frac{1}{L_1} & 0 & 0 & 0 \\ \frac{1}{L_r} & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} v_1 \\ v_r \\ v_\Sigma \\ i_1 \\ i_r \end{bmatrix} + \begin{bmatrix} -\frac{1}{C_1} \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} I_i + \begin{bmatrix} 0 \\ -\frac{1}{C_r} \\ 0 \\ 0 \\ 0 \end{bmatrix} I_s$$

جواب:

$$S = D = j\omega$$

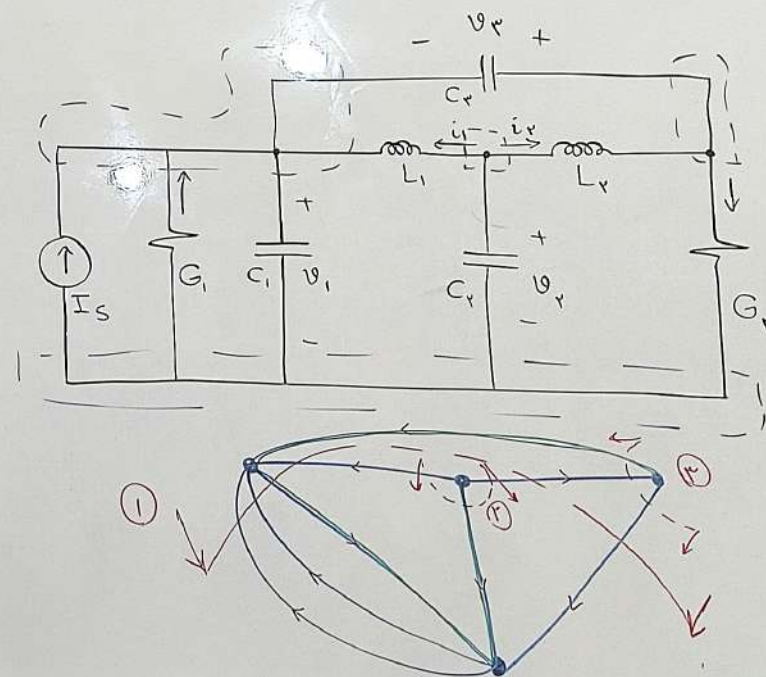
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①

$$x = \begin{bmatrix} v_1 \\ v_r \\ v_r \\ i_1 \\ i_r \end{bmatrix}$$



$$\text{KCL (1)} \quad -I_s - \underbrace{I_{G_1}}_{\text{متغیر غیر حالت}} + C_1 \frac{dv_1}{dt}$$

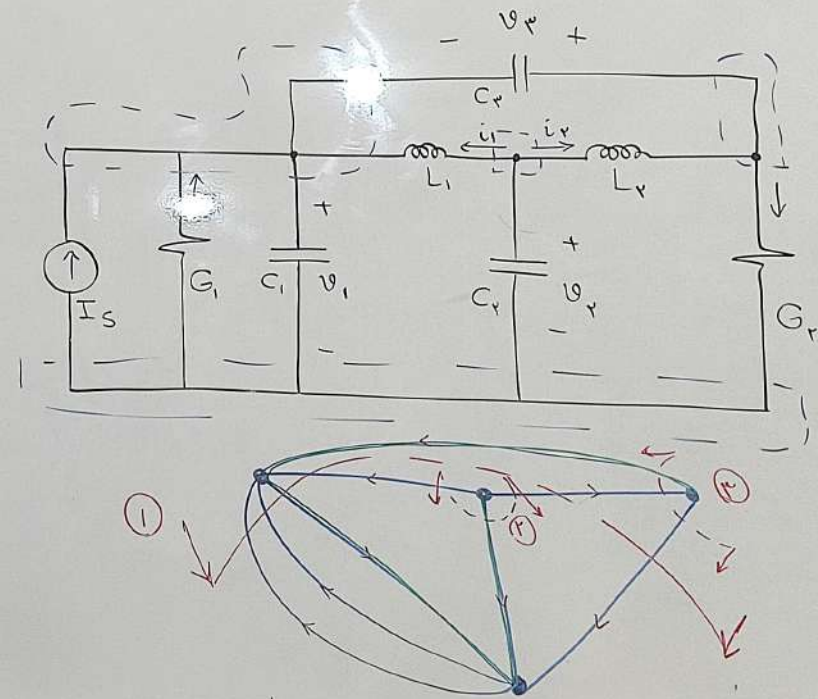
$$\text{KCL (2)} \quad C_r \frac{dv_r}{dt} + i_1 + i_r = 0$$

$$\text{KCL (3)} \quad C_r \frac{dv_r}{dt} - i_r + \underbrace{I_{G_r}}_{\text{متغیر غیر حالت}} = 0$$

$$-i_1 - i_r + \underbrace{I_{G_r}}_{\text{متغیر غیر حالت}} = 0 \quad (a)$$

$$\Rightarrow \frac{dv_r}{dt} = -\frac{1}{C_r} i_1 - \frac{1}{C_r} i_r \quad (2)$$

(b)



$$\text{KVL ①} \rightarrow L_1 \frac{di_1}{dt} + v_1 - v_r = 0$$

$$\text{KVL ②} \rightarrow L_r \frac{di_r}{dt} + v_r + v_1 - v_r = 0$$

$$\frac{di_r}{dt} = -\frac{1}{L_r} v_1 + \frac{1}{L_r} v_r - \frac{1}{L_r} v_r$$

معادہ KVL کی اول

$$(I_{G_r} \times \frac{1}{G_r}) - v_1 - v_r = 0$$

معادہ KVL کی دوم

$$(I_{G_1} \times \frac{1}{G_1}) = v_1$$

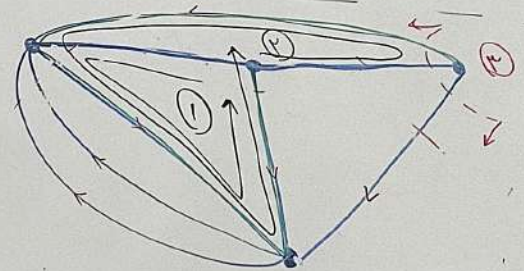
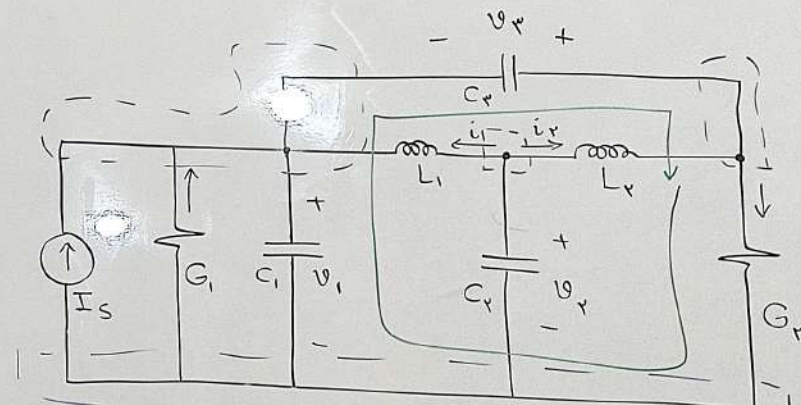
$$\frac{di_1}{dt} = -\frac{1}{L_1} v_1 + \frac{1}{L_1} v_r \quad (*)$$

$$v_r \quad (5)$$

$$= 0 \Rightarrow I_{G_r} = G_r (v_1 + v_r) \quad (c)$$

ساحہ موازی ولتاژ

$$I_{G_1} = G_1 v_1 \quad (d)$$



$$-I_s (-I_{G_1}) + C_1 \frac{dv_1}{dt} - i_1 - i_r +$$

①, ②, ③ $\Rightarrow -I_s - G_1 v_1$

$$\frac{dv_1}{dt} = \frac{(G_1 - G_r) v_1 - G_r v_r}{C_1}$$

$$C_r \frac{dv_r}{dt} - i_r + I_{G_r} = 0 \quad (b)$$

④, ⑤ $\Rightarrow C_r \frac{dv_r}{dt} - i_r$

$$\frac{dv_r}{dt} = -\frac{G_r}{C_r} v_1 - \frac{G_r}{C_r} v_r + \frac{1}{C_r} i_r$$

$$I_{G_r} = 0 \quad (a)$$

$$+ C_1 \frac{dv_1}{dt} - i_1 - i_r + G_r (v_1 + v_r) = 0$$

$$+ \frac{1}{C_1} i_1 + \frac{1}{C_1} i_r + \frac{1}{C_1} I_s \quad (1)$$

$$+ G_r (v_1 + v_r) = 0$$

$$(2)$$

