$$\dot{x} = \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} -\frac{G_1+G_2}{C_1} & \frac{G_2}{G_1} & -\frac{1}{C_1} & -\frac{1}{C_1} & 0 \\ 0 & 0 & -\frac{1}{C_2} & -\frac{1}{C_2} & 0 \\ \frac{G_2}{G_2} & -\frac{G_2}{G_2} & 0 & \frac{1}{C_2} & 0 \\ \frac{1}{L_1} & 0 & 0 & 0 & 0 \\ \frac{1}{L_2} & -\frac{1}{L_2} & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ i_1 \\ i_2 \end{bmatrix} + \begin{bmatrix} -\frac{1}{C_1} \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} I_S$$

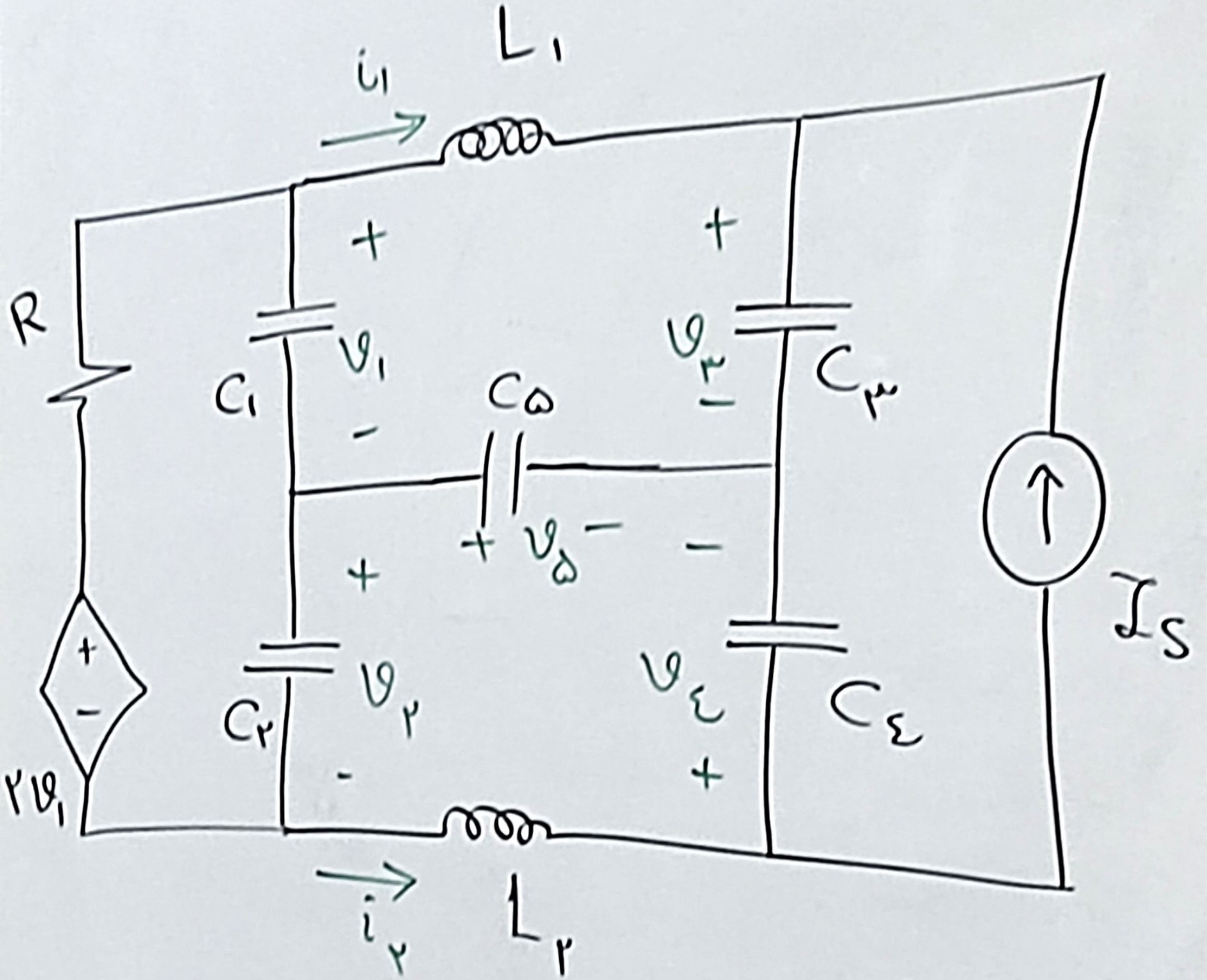
D: $\frac{d}{dt}$

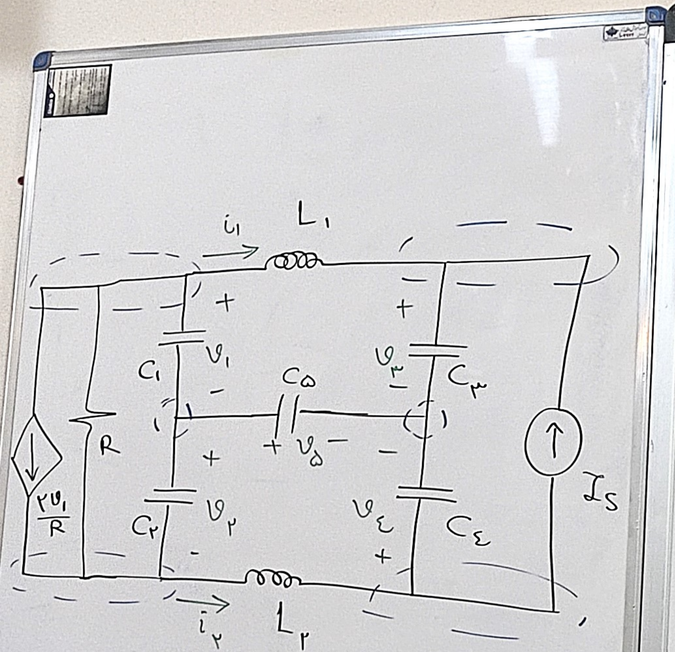
A

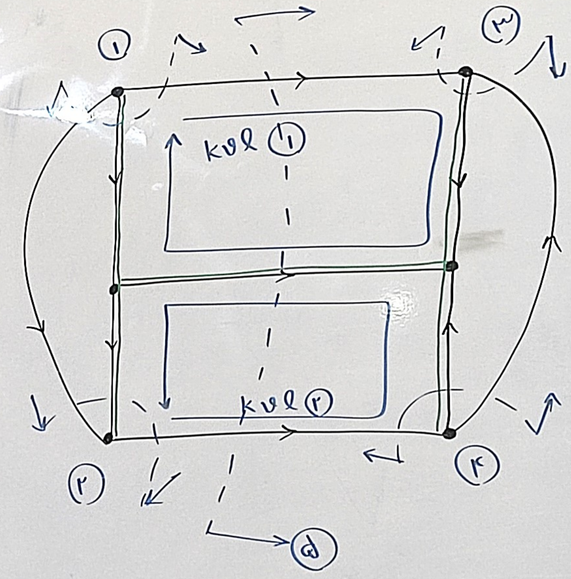
x

B

u


L_1
i_1
R
C_1
v_1
C_5
v_5
v_3
C_3
I_S
$2v_1$
C_2
v_2
v_4
C_4
i_2
L_2





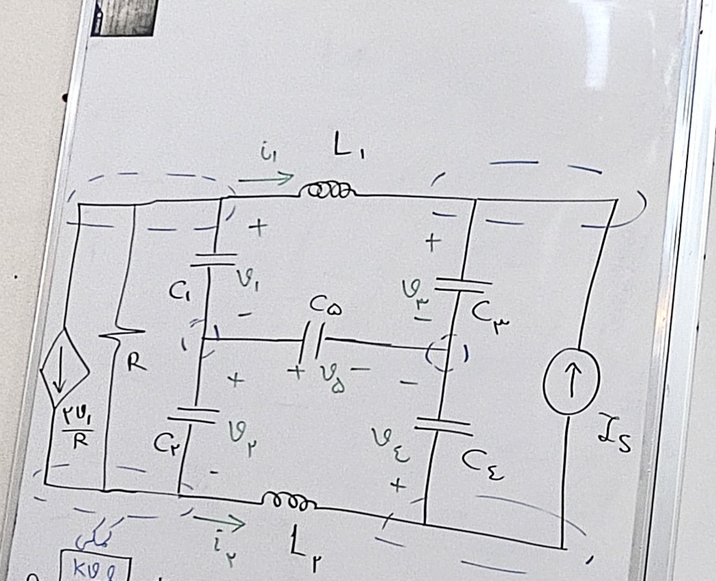
KCL ① $\quad \frac{2v_1}{R} + \underbrace{I_R}_{\text{غیرخالت}} + C_1\frac{dv_1}{dt} + i_1 = 0$ (a)

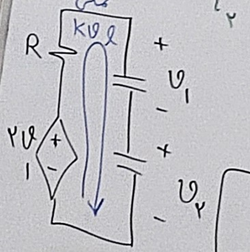
KCL ② $\quad \frac{2v_1}{R} + \underbrace{I_R}_{\text{غیرخالت}} + C_2\frac{dv_2}{dt} - i_2 = 0$ (b)

KCL ④ $\quad C_2\frac{dv_2}{dt} - i_1 - I_S = 0$

$$\frac{dv_2}{dt} = \frac{1}{C_2}i_1 + \frac{1}{C_2}I_S \quad (3)$$

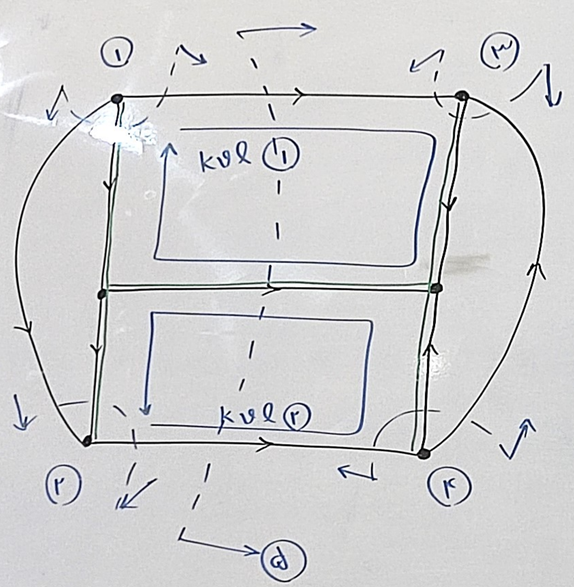
KCL ⑤ $\quad -i_2 + C_4\frac{dv_4}{dt} + I_S = 0 \Rightarrow \frac{dv_4}{dt} = \frac{1}{C_4}i_2 - \frac{1}{C_4}I_S \quad (4)$





KVL (بالا) $\quad -2v_1 + RI_R + v_1 + v_2 = 0$

$$I_R = \frac{v_1 - v_2}{R}$$



KCL ① $\quad \frac{2v_1}{R} + \underbrace{I_R}_{\text{غیرخالت}} + C_1\frac{dv_1}{dt} + i_1 = 0$ (a)

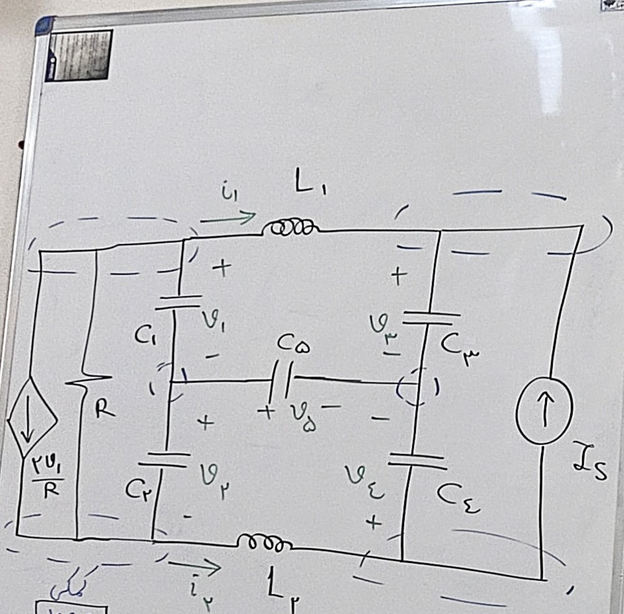
KCL ② $\quad \frac{2v_1}{R} + \underbrace{I_R}_{\text{غیرخالت}} + C_2\frac{dv_2}{dt} - i_2 = 0$ (b)

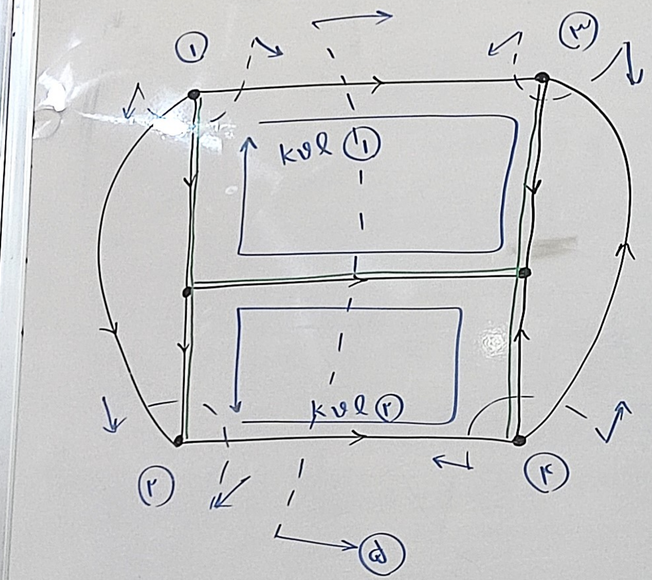
KVL ① $\quad L_1\frac{di_1}{dt} + v_4 - v_0 - v_1 = 0$

$$\frac{di_1}{dt} = \frac{1}{L_1}v_1 - \frac{1}{L_1}v_4 + \frac{1}{L_1}v_0 \quad (6)$$

KVL ② $\quad L_2\frac{di_2}{dt} + v_5 - v_0 + v_2 = 0 \Rightarrow$

$$\frac{di_2}{dt} = -\frac{1}{L_2}v_2 - \frac{1}{L_2}v_5 + \frac{1}{L_2}v_0 \quad (7)$$





KCL ① $\frac{2v_1}{R} + I_R + C_1\frac{dv_1}{dt} + i_1 = 0$ (a)

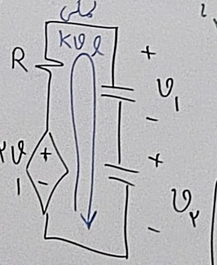
(غیرحالت)

KCL ② $\frac{2v_1}{R} + I_R + C_2\frac{dv_2}{dt} - i_2 = 0$ (b)

(غیرحالت)

KCL ⑤ $C_5\frac{dv_5}{dt} + i_1 + i_2 = 0$

$\frac{dv_5}{dt} = -\frac{1}{C_5}i_1 - \frac{1}{C_5}i_2$ (c)



KVL (بالا) $-2v_1 + RI_R + v_1 + v_2 = 0$

$I_R = \frac{v_1 - v_2}{R}$

KVL ② $L_2\frac{di_2}{dt} + v_4 - v_5 + v_2 = 0 \Rightarrow \frac{di_2}{dt} = -\frac{1}{L_2}v_2 - \frac{1}{L_2}v_4 + \frac{1}{L_2}v_5$ (d)

جایگذاری معادله کمکی در (a) $\Longrightarrow$

(b) ~ ~ ~ $\Longrightarrow$

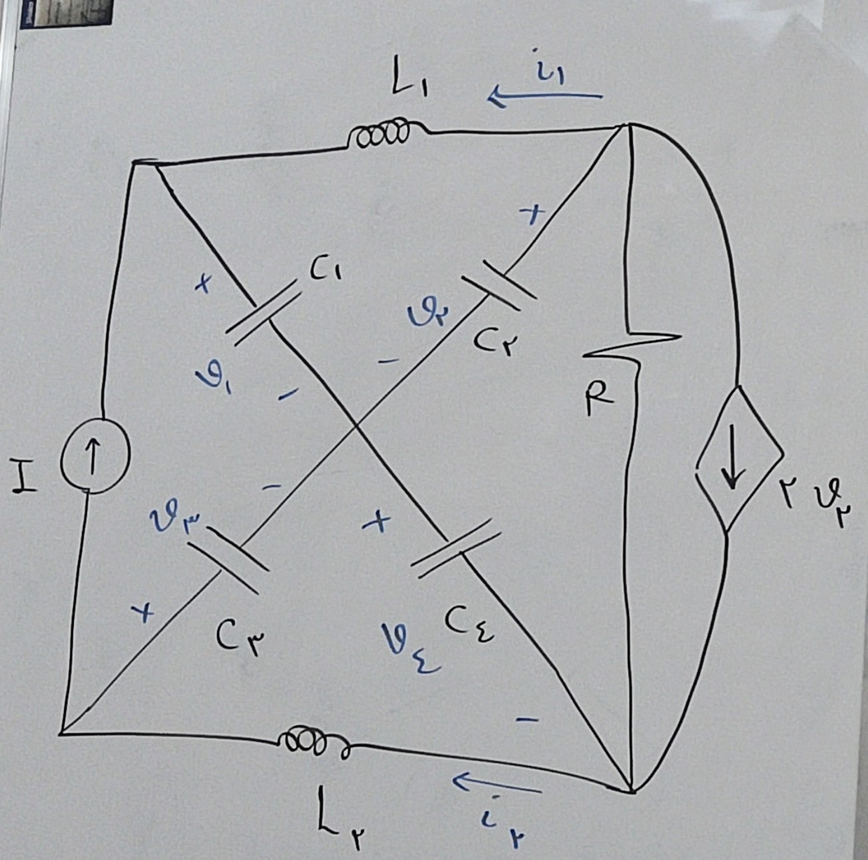
$$I_R = \frac{v_1 - v_2}{R}$$

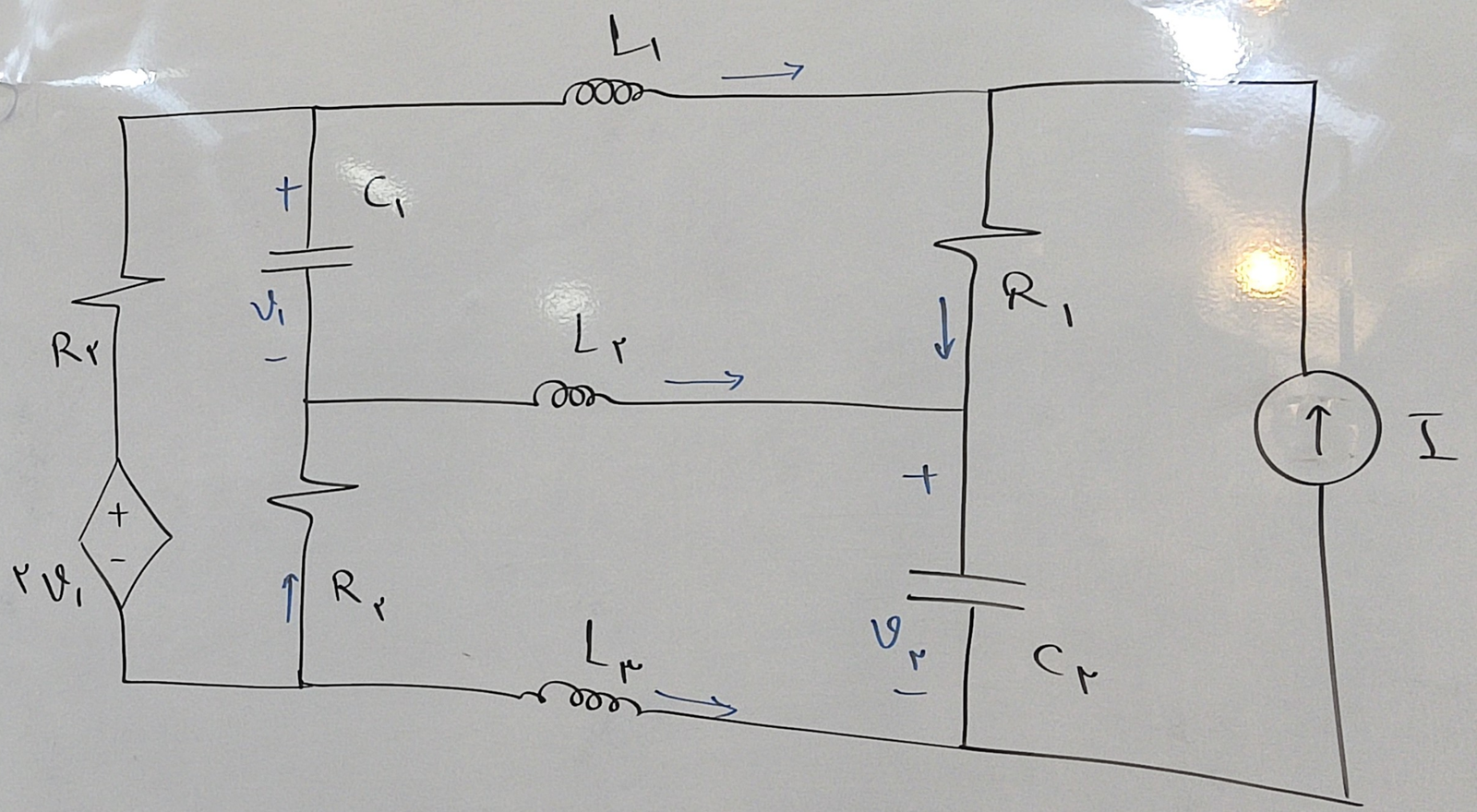
$$\frac{2v_1}{R} + \frac{v_1 - v_2}{R} + C_1 \frac{dv_1}{dt} + i_1 = 0 \Longrightarrow \frac{dv_1}{dt} = \frac{-3}{RC_1} v_1 + \frac{1}{RC_1} v_2 - \frac{1}{C_1} i_1 \quad (1)$$

$$\frac{2v_1}{R} + \frac{v_1 - v_2}{R} + C_2 \frac{dv_2}{dt} - i_2 = 0 \Longrightarrow \frac{dv_2}{dt} = \frac{-3}{RC_2} v_1 + \frac{1}{RC_1} v_2 + \frac{1}{C_2} i_2 \quad (2)$$

$$\dot{x} = \begin{bmatrix} \frac{1}{RC_1} & -\frac{1}{RC_1} & 0 & 0 & 0 & 0 \\ \frac{1}{RC_1} & -\frac{1}{RC_1} & 0 & 0 & 0 & 0 \\ 0 & 0 & \frac{1}{C_2} & 0 & 0 & 0 \\ 0 & 0 & 0 & \frac{1}{C_3} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{1}{C_4} & 0 \\ 0 & 0 & 0 & 0 & 0 & \frac{1}{C_5} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ i_1 \\ i_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \frac{1}{C_2} \\ -\frac{1}{C_4} \\ 0 \\ 0 \\ 0 \end{bmatrix} I_S$$

$$D = S = j\omega$$


L۱
i۱
C۱
C۲
R
I
C۳
C٤
L۲
i۲
۲v۲


L۱
C۱
v۱
R۲
L۲
R۱
I
۲v۱
R۲
L۳
v۲
C۲