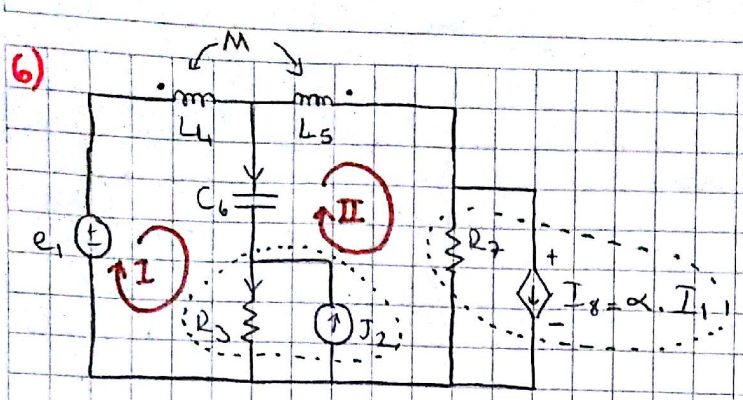
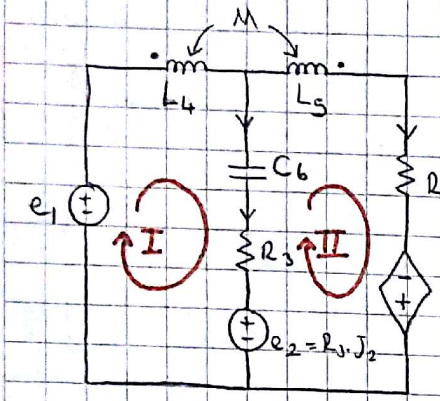
6)



Başlangıç değerleri ≠0. Gösterilen çevreleri s bölgesinde yazıyoruz.

$$X = \begin{bmatrix} I_{c1} \\ I_{c2} \end{bmatrix}$$



$$\begin{bmatrix} V_4(s) \\ V_5(s) \end{bmatrix} = s \begin{bmatrix} L_4 & -M \\ -M & L_5 \end{bmatrix} \begin{bmatrix} I_4(s) \\ I_5(s) \end{bmatrix} - \begin{bmatrix} L_4 & -M \\ -M & L_5 \end{bmatrix} \begin{bmatrix} I_4(t_0) \\ I_5(t_0) \end{bmatrix}$$

$$V_4(s) = s.L_4 I_4(s) - L_4 I_4(t_0) - sMI_5(s) + MI_5(t_0)$$

$$V_5(s) = -sMI_4 + MI_4(t_0) + sL_5 I_5 - L_5 I_5(t_0)$$

1) I) $-V_1 + V_4 + V_6 + V_3 + V_2 = 0$

II) $-V_2 - V_3 - V_6 + V_5 + V_7 - V_8 = 0$

2) I) $-E_1(s) + sL_4 I_4(s) - L_4 I_4(t_0) - sMI_5(s) + MI_5(t_0) + \frac{1}{sC_6} I_6(s) + \frac{V_6(t_0)}{s} + R_3 I_3(s) + R_3 J_2(s) = 0$

II) $-R_3 J_2(s) - R_3 I_3(s) - \frac{1}{sC_6} I_6(s) - \frac{V_6(t_0)}{s} - sMI_4 + MI_4(t_0) + sL_5 I_5 - L_5 I_5(t_0) + R_7 I_7(s) - \alpha . I_1 . R_7 = 0$

3) $I_3 = I_{c1} - I_{c2}$, $I_4 = I_{c1}$, $I_5 = I_{c2}$, $I_6 = I_{c1} - I_{c2}$, $I_7 = I_{c2}$, $I_1 = -I_{c1}$

I) $-E_1 + sL_4 I_{c1} - L_4 I_4(t_0) - sMI_{c2} + MI_5(t_0) + \frac{1}{sC_6}(I_{c1} - I_{c2}) + \frac{V_6(t_0)}{s} + R_3(I_{c1} - I_{c2}) + R_3 J_2(s) = 0$

II) $-R_3 J_2(s) - R_3(I_{c1} - I_{c2}) - \frac{1}{sC_6}(I_{c1} - I_{c2}) - \frac{V_6(t_0)}{s} - sMI_{c1} + MI_4(t_0) + sL_5 I_{c2} - L_5 I_5(t_0) + R_7 I_{c2} + \alpha I_{c1} R_7 = 0$

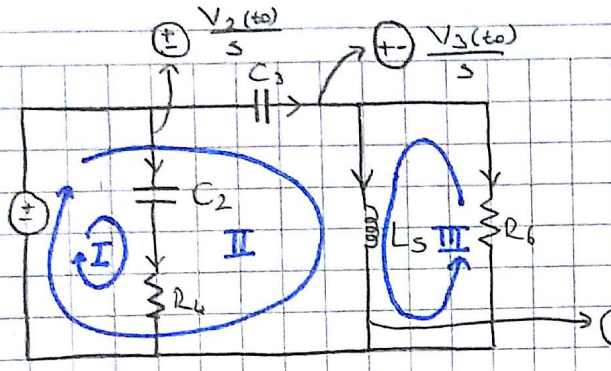
4)

$$\begin{matrix} & I_{c1} & I_{c2} \\ I & sL_4 + \frac{1}{sC_6} + R_3 & -sM - \frac{1}{sC_6} - R_3 \\ II & -R_3 - \frac{1}{sC_6} - sM + \alpha R_7 & R_3 + \frac{1}{sC_6} + sL_5 + R_7 \end{matrix} \begin{bmatrix} I_{c1}(s) \\ I_{c2}(s) \end{bmatrix} = \begin{bmatrix} E_1(s) - R_3 J_2(s) \\ R_3 J_2(s) \end{bmatrix} + \begin{bmatrix} L_4 I_4(t_0) - MI_5(t_0) - \frac{V_6(t_0)}{s} \\ \frac{V_6(t_0)}{s} - MI_4(t_0) + L_5 I_5(t_0) \end{bmatrix}$$

$Z_c(s)$ = bağımsız çevre empedans matrisi

$I_c = E(s)$ + Başlangıç değerleri

7)



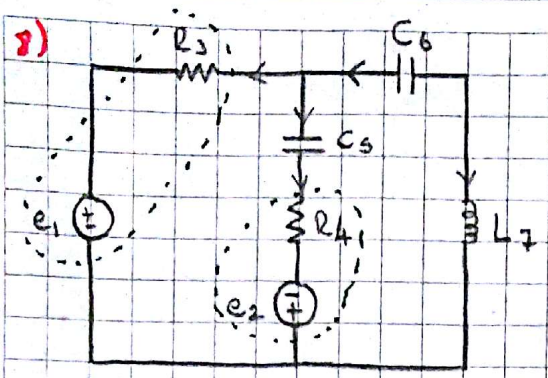
Bağımsız çevre denklemlerinden yararlanarak direk matrisi yazınız.

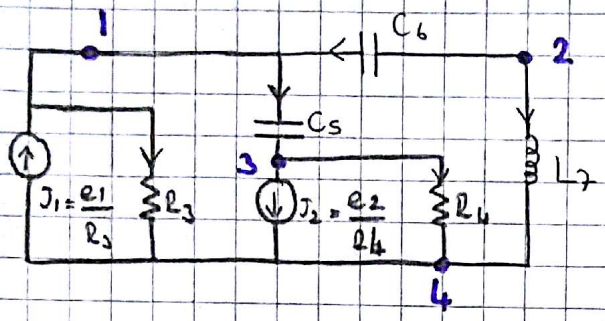
$$V_C(s) = \frac{1}{sC} I(s) + \frac{V(t_0)}{s}$$

$$V_L(s) = sL I(s) - L I(t_0)$$

$$\begin{matrix} & I_{c1} & I_{c2} & I_{c3} \\ \text{I} & \frac{1}{sC_2} + R_4 & 0 & 0 \\ \text{II} & 0 & \frac{1}{sC_3} + sL_5 & sL_5 \\ \text{III} & 0 & sL_5 & sL_5 - R_6 \end{matrix} \begin{bmatrix} I_{c1} \\ I_{c2} \\ I_{c3} \end{bmatrix} = \begin{bmatrix} E_1(s) \\ E_1(s) \\ 0 \end{bmatrix} + \begin{bmatrix} -\frac{V_2(t_0)}{s} \\ \frac{-V_3(t_0)}{s} + L_5 I_5(t_0) \\ L_5 I_5(t_0) \end{bmatrix}$$

8)



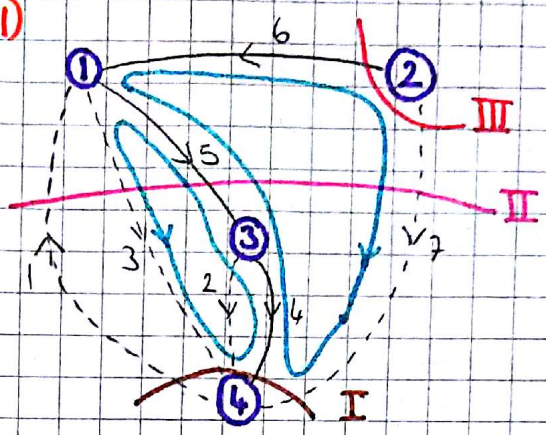


Temel kesitleme denklemleri ile çöz.

n = 4 dal = n-1 = 3

ne = 7 kiriş = ne-n+1 = 4

1)



$$X = \begin{bmatrix} V_4 \\ V_5 \\ V_6 \end{bmatrix}$$

2) I) $-I_1 + I_3 + I_2 + I_4 + I_7 = 0$

II) $-I_1 + I_3 + I_5 + I_7 = 0$

III) $I_7 + I_6 = 0$

3) I) $-\frac{E_1(s)}{R_3} + G_3 V_3 + \frac{E_2(s)}{R_4} + G_4 V_4 + \frac{1}{sL_7} V_7(s) + \frac{I_7(t_0)}{s} = 0$

$V_3 = V_4 + V_5$

$V_7 = V_4 + V_5 + V_6$

II) $-\frac{E_1(s)}{R_3} + G_3 V_3 + sC_5 V_5(s) - C_5 V_5(t_0) + \frac{1}{sL_7} V_7(s) + \frac{I_7(t_0)}{s} = 0$

III) $\frac{1}{sL_7} V_7(s) + \frac{I_7(t_0)}{s} + sC_6 V_6(s) - C_6 V_6(t_0) = 0$

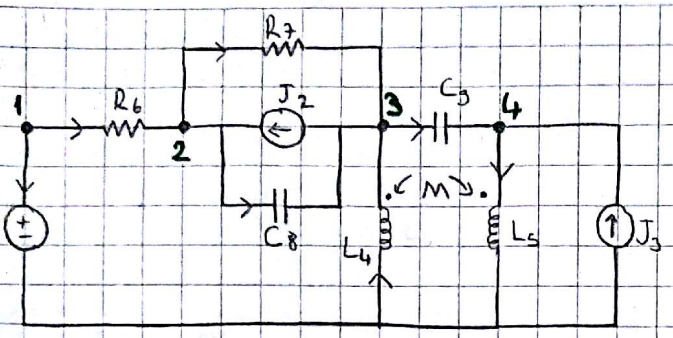
I) $-\frac{E_1(s)}{R_3} + G_3 V_4 + G_3 V_5 + \frac{E_2(s)}{R_4} + G_4 V_4 + \frac{1}{sL_7}(V_4 + V_5 + V_6) + \frac{I_7(t_0)}{s} = 0$

II) $-\frac{E_1(s)}{R_3} + G_3 (V_4 + V_5) + sC_5 V_5(s) - C_5 V_5(t_0) + \frac{1}{sL_7}(V_4 + V_5 + V_6) + \frac{I_7(t_0)}{s} = 0$

III) $\frac{1}{sL_7}(V_4 + V_5 + V_6) + \frac{I_7(t_0)}{s} + sC_6 V_6(s) - C_6 V_6(t_0) = 0$

$$\begin{matrix} & V_4 & V_5 & V_6 \\ \text{I} & G_3 + G_4 + \frac{1}{sL_7} & G_3 + \frac{1}{sL_7} & \frac{1}{sL_7} \\ \text{II} & G_3 + \frac{1}{sL_7} & G_3 + sC_5 + \frac{1}{sL_7} & \frac{1}{sL_7} \\ \text{III} & \frac{1}{sL_7} & \frac{1}{sL_7} & \frac{1}{sL_7} + sC_6 \end{matrix} \begin{bmatrix} V_4 \\ V_5 \\ V_6 \end{bmatrix} = \begin{bmatrix} \frac{E_1(s)}{R_3} - \frac{E_2(s)}{R_4} \\ \frac{E_1(s)}{R_3} \\ 0 \end{bmatrix} + \begin{bmatrix} -\frac{I_7(t_0)}{s} \\ C_5 V_5(t_0) - \frac{I_7(t_0)}{s} \\ C_6 V_6(t_0) - \frac{I_7(t_0)}{s} \end{bmatrix}$$

10)



Düğüm denklemleri yöntemiyle çözün.

$$X = \begin{bmatrix} I_1 \\ \cancel{V_{d1}} \\ V_{d2} \\ V_{d3} \\ V_{d4} \end{bmatrix} \qquad V_{d1} = e_1$$

1)

$$\begin{bmatrix} V_4 \\ V_5 \end{bmatrix} = s \begin{bmatrix} L_4 & -M \\ -M & L_5 \end{bmatrix} \begin{bmatrix} I_4 \\ I_5 \end{bmatrix} - \begin{bmatrix} L_4 & -M \\ -M & L_5 \end{bmatrix} \begin{bmatrix} I_{4(t_0)} \\ I_{5(t_0)} \end{bmatrix} \qquad \begin{bmatrix} I_4 \\ I_5 \end{bmatrix} = \begin{bmatrix} L_5/\Delta_s & M/\Delta_s \\ M/\Delta_s & L_4/\Delta_s \end{bmatrix} \begin{bmatrix} V_4 \\ V_5 \end{bmatrix} + \begin{bmatrix} I_{4(t_0)}/s \\ I_{5(t_0)}/s \end{bmatrix}$$

2) I) $I_6 + I_1 = 0$

II) $-I_2 - I_6 + I_7 + I_8 = 0$

III) $I_2 - I_8 - I_7 + I_5 - I_4 = 0$

IV) $-I_5 + I_5 - I_3 = 0$

3) I) $I_1 + G_6 . V_6 = 0$

II) $-J_2 - G_6 V_6 + G_7 V_7 + sC_8 V_8(s) - C_8 V_{8(t_0)} = 0$

III) $J_2 - sC_8 V_8(s) + C_8 V_{8(t_0)} - G_7 V_7 + sC_5 V_5(s) - C_5 V_{5(t_0)} - \frac{L_5}{\Delta_s} V_4 - \frac{M}{\Delta_s} V_5 - \frac{I_{4(t_0)}}{s} = 0$

IV) $-sC_5 V_5 + C_5 V_{5(t_0)} + \frac{M}{\Delta_s} V_4 + \frac{L_4}{\Delta_s} V_5 + \frac{I_{4(t_0)}}{s} - J_3 = 0$

$V_4 = -V_{d3}$, $V_5 = V_{d4}$, $V_6 = V_{d1} - V_{d2} = e_1 - V_{d2}$, $V_7 = V_{d2} - V_{d3}$, $V_8 = V_{d2} - V_{d3}$, $V_5 = V_{d3} - V_{d4}$

I) $I_1 + G_6 (e_1 - V_{d2}) = 0$

II) $-J_2 - G_6 (e_1 - V_{d2}) + G_7 (V_{d2} - V_{d3}) + sC_8 (V_{d2} - V_{d3}) - C_8 V_{8(t_0)} = 0$

III) $J_2 - sC_8 (V_{d2} - V_{d3}) + C_8 V_{8(t_0)} - G_7 (V_{d2} - V_{d3}) + sC_5 (V_{d3} - V_{d4}) - C_5 V_{5(t_0)} + \frac{L_5}{\Delta_s} V_{d3} - \frac{M}{\Delta_s} V_{d4} - \frac{I_{4(t_0)}}{s} = 0$

IV) $sC_5 (V_{d3} - V_{d4}) + C_5 V_{5(t_0)} - \frac{M}{\Delta_s} V_{d3} + \frac{L_4}{\Delta_s} V_{d4} + \frac{I_{4(t_0)}}{s} - J_3 = 0$

4)

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array}\begin{array}{c} \begin{array}{cccc} I_1 & V_{d2} & V_{d3} & V_{d4} \end{array} \\ \begin{bmatrix} 1 & -G_6 & 0 & 0 \\ 0 & G_6+G_7+sC_8 & -G_7-sC_4 & 0 \\ 0 & -sC_8-G_7 & sC_8+G_7+sC_9+\frac{L_5}{\Delta_5} & \frac{-M}{\Delta_5}sC_9 \\ 0 & 0 & -sC_9-\frac{M}{\Delta_5} & sC_9+\frac{L_4}{\Delta_5} \end{bmatrix} \end{array} \begin{bmatrix} I_1 \\ V_{d2} \\ V_{d3} \\ V_{d4} \end{bmatrix} = \begin{bmatrix} -G_6E_1(s) \\ -G_6E_1(s)+J_2(s) \\ -J_2(s) \\ J_3(s) \end{bmatrix} + \begin{bmatrix} 0 \\ C_8V_8(t_0) \\ -C_8V_8(t_0)+C_9V_9(t_0)+\frac{I_4(t_0)}{s} \\ -C_9V_9(t_0)-\frac{I_4(t_0)}{s} \end{bmatrix}$$