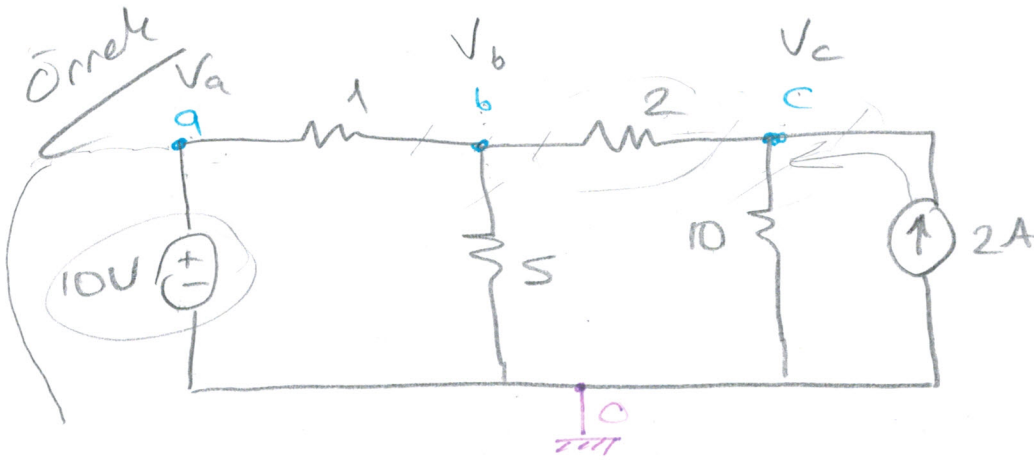# 3) Devre Analiz Teknikleri

3.1) Node Analysis - Düğüm Analizi:

Kirchoff'un akım kanunu kullanılarak geliştirilen analiz yöntemidir.

- İlk önce referans nokta seçilir. Referans noktası sıfır potansiyele sahip toprak noktasıdır.
- Referans seçildikten sonra diğer düğüm noktaları isimlendirilir.
- Son adımda referans dışındaki her düğüm noktasına KCL uygulanır.

Örnek

KCL

$V_a = 10V$

düğüm b $\Rightarrow \dfrac{V_b - V_a}{1} + \dfrac{V_b - V_c}{2} + \dfrac{V_b - 0}{5} = 0$

düğüm c $\Rightarrow \dfrac{V_c - V_b}{2} + \dfrac{V_c - 0}{10} - 2 = 0$

$V_b - 10 + \dfrac{V_b - V_c}{2} + \dfrac{V_b}{5} = 0$

$10 V_b - 100 + 5 V_b - 5 V_c + 2 V_b = 0$

$17 V_b - 5 V_c = 100$

$$\frac{V_c - V_b}{2} + \frac{V_c}{10} = 2$$

$$\Rightarrow 5V_c - 5V_b + V_c = 20$$

$$5 / \; 6V_c - 5V_b = 20$$
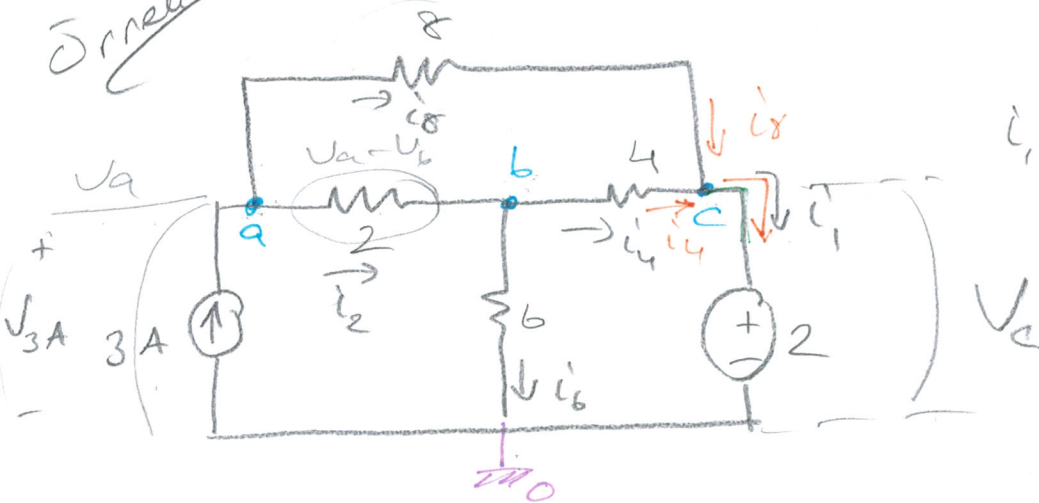
$$6 / \; -5V_c + 17V_b = 100$$

$$30V_c - 25V_b = 100$$

$$-30V_c + 102V_b = 600$$

$$77V_b = 700$$

$$V_b = 9,09 \, V$$

$$6V_c = 20 + 5(9,0)$$

$$V_c = 10,90 \, V$$

Örnek

i_1, i_2, i_4, i_8, i_6 ve

$U_{3A} = ?$

Düğüm a: $-3 + \dfrac{V_a - V_b}{2} + \dfrac{V_a - V_c}{8} = 0$

Düğüm b: $\dfrac{V_b - V_a}{2} + \dfrac{V_b}{6} + \dfrac{V_b - V_c}{4} = 0$

Düğüm c: $V_c = 2V$

$\rightarrow$ $\dfrac{V_a - V_b}{2} + \dfrac{V_a - 2}{8} = 3$

 4

$4V_a - 4V_b + V_a - 2 = 24$

$5V_a - 4V_b = 26$ —

$\rightarrow$ $\dfrac{V_b - V_a}{2} + \dfrac{V_b}{6} + \dfrac{V_b - 2}{4} = 0$

 $6 \qquad 2 \qquad 3$

$6V_b - 6V_a + 2V_b + 3V_b - 6 = 0$

$11V_b - 6V_a = 6$ —

$6/\ 5V_a - 4V_b = 26$

$5/\ -6V_a + 11V_b = 6$

_____

$30V_a - 24V_b = 156$

$-30V_a + 55V_b = 30$

_____

$31V_b = 186$

$V_b = 6$
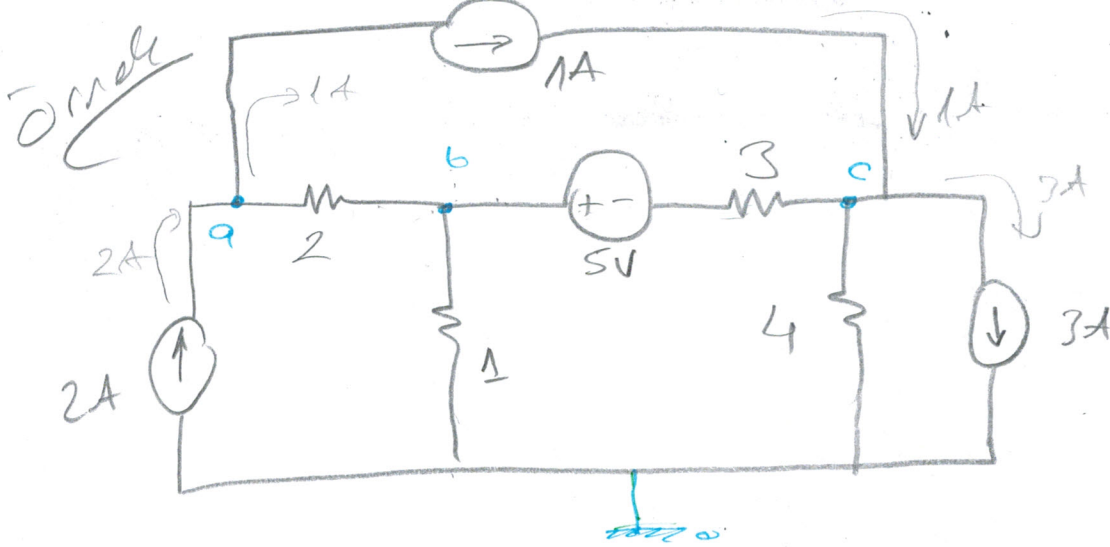
$5V_a - 4V_b = 26$

$5V_a = 50$

$V_a = 10V = V_{3A}$

$i_2 = \dfrac{V_a - V_b}{2} = \dfrac{10 - 6}{2} = 2A$

$i_8 = \dfrac{V_a - V_c}{8} = \dfrac{10 - 2}{8} = 1A$

$i_4 = \dfrac{V_b - V_c}{4} = \dfrac{6 - 2}{4} = 1A$

$i_4 = i_8 + i_4 = 1 + 1 = 2A$

$i_6 = \dfrac{V_b}{6} = \dfrac{6}{6} = 1A$

Örnek

Düğüm a: $1 - 2 + \dfrac{U_a - U_b}{2} = 0$

Düğüm b: $\dfrac{V_b - V_a}{2} + \dfrac{V_b}{1} + \dfrac{V_b - (5 + V_c)}{3} = 0$

Düğüm c: $3 - 1 + \dfrac{V_c}{4} + \dfrac{V_c - (-5 + V_b)}{3} = 0$

$V_a - V_b = 2 \; - - - \; \textcircled{1}$

$3V_b - 3V_a + 6V_b + 2V_b - 10 - 2V_c = 0$

$11V_b - 3V_a - 2V_c = 10 \; - - - - \; \textcircled{2}$

$3V_c + 4V_c + 20 - 4V_b + 24 = 0$

$4V_b - 7V_c = 44 \; - - - \; \textcircled{3}$

$$V_a - U_b = 2$$

$$-3V_a + 11V_b - 2V_c = 10$$

$$4V_b - 7V_c = 44$$

I. yol

$$\begin{bmatrix} 1 & -1 & 0 \\ -3 & 11 & -2 \\ 0 & 4 & -7 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 2 \\ 10 \\ 44 \end{bmatrix}$$

$\Delta \rightarrow$ determinant
hesaplan.

$$V_a = \frac{\Delta_a}{\Delta} \qquad V_c = \frac{\Delta}{\Delta}$$

$$V_b = \frac{\Delta_b}{\Delta}$$

II. yol

$$V_a - V_b = 2$$

$$-3V_a + 11V_b - 2V_c = 10$$

$$4V_b - 7V_c = 44 \rightarrow V_c = \frac{4V_b - 44}{7}$$

$$-3V_a + 11V_b - 2\left(\frac{4V_b - 44}{7}\right) = 10$$

$$-21V_a + 77V_b - 8V_b + 88 = 70$$

$$-21V_a + 69V_b = -18$$

$$V_a - V_b = 2 \rightarrow V_a = 2 + V_b$$

$$-21(2 + V_b) + 69V_b = -18$$

$$-42 - 21V_b + 69V_b = -18 \rightarrow \quad 48V_b = 24$$

$$V_b = 0.5V$$
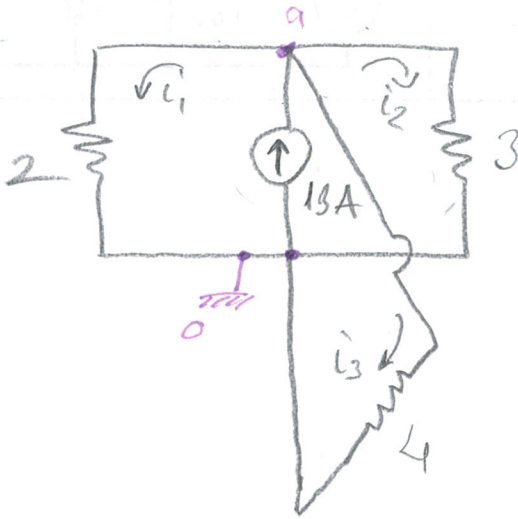
$V_a = 2,5 V$

$V_c = \dfrac{4V_b - 44}{7} = \dfrac{2 - 44}{7} = -6 V$

Örnek

$i_1, i_2, i_3 = ?$

Düğüm a:

$$\dfrac{V_a}{2} + \dfrac{V_a}{4} + \dfrac{V_a}{3} - 13 = 0$$
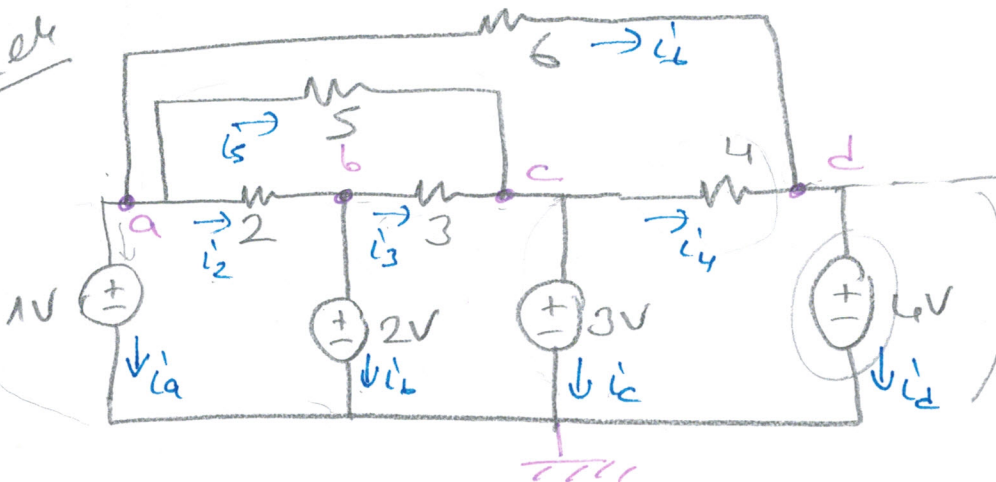
$$6V_a + 3V_a + 4V_a = 12 \cdot 13$$

$$13 V_a = 12 \cdot 13$$

$$V_a = 12 V$$

$i_1 = \dfrac{V_a}{2} = 6 A$

$i_2 = \dfrac{V_a}{3} = 4 A \qquad i_3 = \dfrac{V_a}{4} = 3 A$

Örnek

Devrede bütün kollardan geçen akım ları bulun.

$$U_a = 1V \quad U_b = 2V \quad U_c = 3V \quad U_d = 4V$$

$$i_2 = \frac{V_a - V_b}{2} = \frac{1-2}{2} = -0,5A$$

$$i_3 = \frac{V_b - V_c}{3} = \frac{2-3}{3} = -1/3 \; A$$

$$i_4 = \frac{V_c - V_d}{4} = \frac{3-4}{4} = -1/4 \; A$$

$$i_5 = \frac{V_a - V_c}{5} = \frac{1-3}{5} = -2/5 \; A$$

$$i_6 = \frac{V_a - V_d}{6} = \frac{1-4}{6} = -3/6 \; A$$

Düğüm a için KCL:

$$i_a + i_2 + i_5 + i_6 = 0 \qquad i_a = -(i_2 + i_5 + i_6)$$

$$= -(-0,5 - 2/5 - 3/6) = 7/5 \; A$$

Düğüm b için KCL:

$$i_b + i_3 - i_2 = 0$$

Düğüm c için KCL:

$$i_c + i_4 - i_3 - i_5 = 0$$

Düğüm d için KCL

$$i_d - i_4 - i_6 = 0$$