

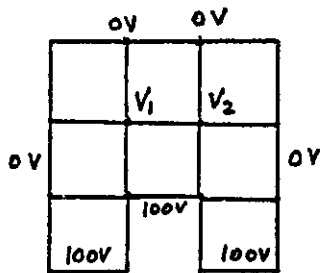
## **CHAPTER - 12**

# **COMPUTER-AIDED ANALYSIS OF ELECTROMAGNETIC FIELDS**

## CHAPTER 12

### COMPUTER-AIDED ANALYSIS OF ELECTROMAGNETIC FIELDS

#### Exercise 12.1



$$0 + 0 + 100 + V_2 - 4V_1 = 0$$

$$0 + V_1 + 100 + 0 - 4V_2 = 0$$

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$$-4V_1 + V_2 = -100$$

$$V_1 - 4V_2 = -100$$

$$\begin{bmatrix} -4 & 1 \\ 1 & -4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} -100 \\ -100 \end{bmatrix}$$

A : coefficient matrix

From the above equations  $V_1 = 33.33 \text{ V}$ ,  $V_2 = 33.33 \text{ V}$

#### Exercise 12.2

$$\text{Let } V_1^{(0)} = V_2^{(0)} = 50$$

Iteration 1 :

$$V_1^{(1)} = 50 + \frac{1}{4} (0 + 0 + 100 + 50 - 4 \times 50) = 37.5$$

$$|V_1^{(1)} - V_1^{(0)}| = |37.5 - 50| = 12.5$$

$$V_2^{(1)} = 50 + \frac{1}{4} (0 + 37.5 + 100 + 0 - 4 \times 50) = 34.38$$

$$|V_2^{(1)} - V_2^{(0)}| = |34.38 - 50| = 15.62$$

Iteration 2:

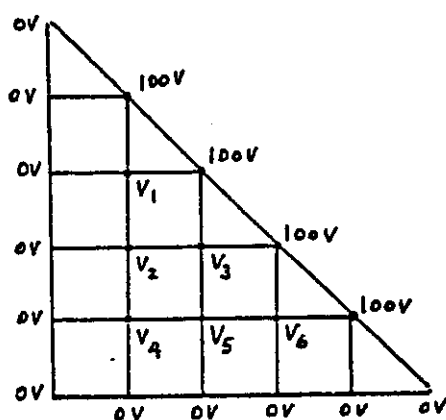
$$V_1^{(2)} = 37.5 + \frac{1}{4} (0 + 0 + 100 + 34.38 - 4 \times 37.5) = 33.6$$

$$|V_1^{(2)} - V_1^{(1)}| = |33.6 - 37.5| = 3.9$$

$$V_2^{(2)} = 34.38 + \frac{1}{4} (0 + 33.6 + 100 + 0 - 4 \times 34.38) = 33.4$$

$$|V_2^{(2)} - V_1^{(2)}| = |33.4 - 34.38| = 0.98$$

Problem 12.1



$$-4V_1 + V_2 = -200$$

$$V_1 - 4V_2 + V_3 + V_4 = 0$$

$$V_2 - 4V_3 + V_5 = -200$$

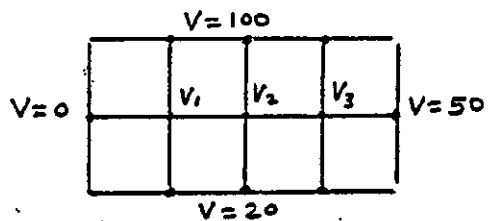
$$V_2 - 4V_4 + V_5 = 0$$

$$V_3 + V_4 - 4V_5 + V_6 = 0$$

$$V_5 - 4V_6 = -200$$

$$\begin{bmatrix} -4 & 1 & 0 & 0 & 0 & 0 \\ 1 & -4 & 1 & 1 & 0 & 0 \\ 0 & 1 & -4 & 0 & 1 & 0 \\ 0 & 1 & 0 & -4 & 1 & 0 \\ 0 & 0 & 1 & 1 & -4 & 1 \\ 0 & 0 & 0 & 0 & 1 & -4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \end{bmatrix} = \begin{bmatrix} -200 \\ 0 \\ -200 \\ 0 \\ 0 \\ -200 \end{bmatrix}$$

Problem 12.3



$$100 + 0 + 20 + V_2 - 4V_1 = 0$$

$$100 + V_1 + 20 + V_3 - 4V_2 = 0$$

$$100 + V_2 + 20 + 50 - 4V_3 = 0$$

$$\begin{bmatrix} -4 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & -4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} -120 \\ -120 \\ -170 \end{bmatrix}$$

$$V_1 = 43.75 \text{ V}, \quad V_2 = 55 \text{ V}, \quad V_3 = 56.25 \text{ V}$$