Chapter three: METHODS OF ANALYSIS

3.1: Introduction

Circuit analysis means to find a current through or voltage across any branch of circuit. Before discussion the methods that used of circuit analysis, we need to know how can solve the simultaneous linear equations? An easier method used for solving simultaneous linear equations involves using *determinants.*

3.1.1 Determinants (D)

A determinant is a set of coefficients which has the same number of rows and columns and which may be expressed as a single value.

Consider the two simultaneous linear equations are

$$a_{11}x_1 + a_{12}x_2 = b_1 \quad \text{..........} \ (1)$$
$$a_{21}x_1 + a_{22}x_2 = b_2 \quad \text{...........} \ (2)$$

Where x_1 and x_2 are the unknown variables, and a_{11}, a_{12}, a_{21}, a_{22}, b_1 and b_2 are constants.

$$x_2 = \frac{\Delta_2}{\Delta} = \frac{\begin{vmatrix} 2 & -2 \\ 1 & 5 \end{vmatrix}}{-4} = \frac{10+2}{-4} = \frac{12}{-4} = -3$$

$$D = a_{11}a_{22} - a_{12}a_{22}$$

The unknown variables x_1 and x_2 are found by using a technique called *Cramer's rule.*

$$x_1 = \frac{\Delta_1}{\Delta} = = \frac{\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}} = \frac{b_1 a_{22} - a_{12}b_2}{a_{11}a_{22} - a_{12}a_{21}}$$

$$x_2 = \frac{\Delta_2}{\Delta} = \frac{\begin{vmatrix} a_{11} & b_1 \\ a_{21} & b_2 \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}} = \frac{a_{11}b_2 - b_1 a_{21}}{a_{11}a_{22} - a_{12}a_{21}}$$

Δ, Δ_1 and Δ_2 are called second order determinants since they contain of two rows and two columns.

To solve three simultaneous linear equations third order determinants are used.

Consider the following three simultaneous linear equations:

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + a_{13}x_3 &= b_1 \\ a_{21}x_1 + a_{22}x_2 + a_{23}x_3 &= b_2 \\ a_{31}x_1 + a_{32}x_2 + a_{33}x_3 &= b_3 \end{aligned}$$

The unknown variables x_1, x_2 and x_3 are determined as follows:

$$x_1 = \frac{\Delta_1}{\Delta} = D = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$$

$$x_2 = \frac{\Delta_2}{\Delta} = = \frac{\begin{vmatrix} a_{11} & b_1 & a_{13} \\ a_{21} & b_2 & a_{23} \\ a_{31} & b_3 & a_{33} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}}$$