where, $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$; $D_1 = \begin{vmatrix} k_1 & b_1 & c_1 \\ k_2 & b_2 & c_2 \\ k_3 & b_3 & c_3 \end{vmatrix}$; $D_2 = \begin{vmatrix} a_1 & k_1 & c_1 \\ a_2 & k_2 & c_2 \\ a_3 & k_3 & c_3 \end{vmatrix}$; $D_3 = \begin{vmatrix} a_1 & b_1 & k_1 \\ a_2 & b_2 & k_2 \\ a_3 & b_3 & k_3 \end{vmatrix}$

***Important Conditions*:–**

Case I:- (When D ≠ 0)

The system of linear equations will be consistent, independent & it has unique solution.

Case II:- (When $D = D_1 = D_2 = D_3 = 0$)

The system of linear equations will be consistent, dependent & it has infinite no. of solutions.

Case III:- (When D = 0 & at least one of D_1, D_2, D_3 is $\neq 0$)

The system of linear equations will be inconsistent & it has no solution.

Matrix

Basic Form:-

$A = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}$; $Order = R \times C$

(1) *A matrix A is said to be square matrix iff* $R = C$.

(2) *If all the elements in A are zero, then A is said to be a Null (or zero) matrix, denoted by O.*

E.g. $A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

(3) *If a matrix have only diagonal terms & the other terms are zero, then it is called diagonal matrix.*

E.g. $A = \begin{bmatrix} 17 & 0 \\ 0 & 7 \end{bmatrix}$

(4) *If all the terms in a diagonal matrix are only* 1, *then it is called unit or identity matrix.*

E.g. $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(5) *If* $A^T = A$, *then A is a symmetric matrix.*

(6) *If* $A^T = -A$, *then A is a skew – symmetric matrix.*

(7) *If* $|A| = 0$, *then A is a singular matrix.*

(8) *If* $A^T A = I$, *then A is an orthogonal matrix.*

(9) *If* $A^2 = A$, *then A is an idempotent matrix.*

(10) *If* $A^2 = I$, *then A is an involutory matrix.*

(11) *If* $A^k = O$, *then A is a nilpotent matrix.*

(12) *If the rows & columns of a matrix are interchanged, then it is called transpose matrix* A^T.

(13) *If a diagonal matrix have all the terms same, then it is called scalar matrix.*

(14) **Equal Matrices:-**

If $A = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}$ & $B = \begin{bmatrix} c_1 & d_1 \\ c_2 & d_2 \end{bmatrix}$; *then* $A = B$ *iff* $a_1 = c_1, a_2 = c_2, b_1 = d_1, b_2 = d_2$.

(15) **Addition & Subtraction of matrices:-**

$A = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}, B = \begin{bmatrix} c_1 & d_1 \\ c_2 & d_2 \end{bmatrix}$, *then* $A \pm B = \begin{bmatrix} a_1 \pm c_1 & b_1 \pm d_1 \\ a_2 \pm c_2 & b_2 \pm d_2 \end{bmatrix}$.

(16) **Multiplication by a scalar k:-**