(13) **Skew Symmetric Matrix:** A square matrix $A = (a_{ij})$ is said to be skew symmetric if $a_{ij} = -a_{ij}$ for all i and j on both sides of the diagonal i.e $a_{12} = -a_{21}$, $a_{13} = -a_{31}$, $a_{23} = -a_{32}$ etc. and $a_{11} = a_{22} = a_{33} \cdots = a_{nn}$.

For example:-

(1) $\begin{bmatrix} 0 & -2 & -4 \\ 2 & 0 & -5 \\ 4 & 5 & 0 \end{bmatrix}_{3\times3}$ (ii) $\begin{bmatrix} 0_{11} & a_{12} & a_{13} \\ -a_{21} & 0_{22} & a_{23} \\ -a_{31} & -a_{32} & a_{33} \end{bmatrix}_{3\times3}$

(14) **Idempotent Matrix:** A symmetric matrix is called Idempotent matrix when it re-produces itself as a result of multiplied by itself. For example;

(1) $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}_{2\times2}$, Then $A^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

(ii) $B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ Then; $B \cdot B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = B$

$\therefore B^2 = B$

16 **Singular and Non-Singular Matrix**:- A square matrix A is said to be non-singular if its determinant $|A| \neq 0$. On the contrary, if $|A| = 0$, then matrix A is called a singular matrix.

For example:

(i) $A = \begin{bmatrix} 2 & 8 \\ 1 & 4 \end{bmatrix} = 8 - 8 = 0$

$\therefore$ A is a singular matrix.

(ii) $B = \begin{bmatrix} 3 & 6 \\ 2 & 3 \end{bmatrix} = 9 - 12 = -3 \neq 0$

$\therefore$ B is a non-singular matrix.

(iii) Test whether the following matrix is singular or non-singular: $\begin{bmatrix} 4 & 5 & 8 \\ 2 & 0 & 4 \\ 3 & 1 & 6 \end{bmatrix}_{3\times3}$

Sol^n:- Let $A = \begin{bmatrix} 4 & 5 & 8 \\ 2 & 0 & 4 \\ 3 & 1 & 6 \end{bmatrix}$

$|A| = \begin{vmatrix} 4 & 5 & 8 \\ 2 & 0 & 4 \\ 3 & 1 & 6 \end{vmatrix}$

$= 4\begin{vmatrix} 0 & 4 \\ 1 & 6 \end{vmatrix} - 5\begin{vmatrix} 2 & 4 \\ 3 & 6 \end{vmatrix} + 8\begin{vmatrix} 2 & 0 \\ 3 & 1 \end{vmatrix}$

$= 4(0-4) - 5(12-12) + 8(2-0)$

$= 4 \times 2 - 5.0 + 8 \times 2$

$= -16 - 0 + 16 = 0$ $\therefore$ It is singular.

Operation on Matrices

Addition of Matrices:- Two matrices can be added if and only if they have the same dimension i.e they have same number of rows and columns. In that case, the addition of $A = [a_{ij}]$ and $B = [b_{ij}]$ is defined as the addition of each pair of corresponding elements.

For example:-

① $A = \begin{bmatrix} 4 & 9 \\ 2 & 1 \end{bmatrix}_{2\times2}$ and $B = \begin{bmatrix} 2 & 0 \\ 0 & 7 \end{bmatrix}_{2\times2}$

$$\therefore A + B = \begin{bmatrix} 4 & 9 \\ 2 & 1 \end{bmatrix} + \begin{bmatrix} 2 & 0 \\ 0 & 7 \end{bmatrix} = \begin{bmatrix} 4+2 & 9+0 \\ 2+0 & 1+7 \end{bmatrix}$$

$$= \begin{bmatrix} 6 & 9 \\ 2 & 8 \end{bmatrix}_{2\times2}$$

properties of Matrix Addition:-

(i) Addition of matrices is commutative: $A+B = B+A$

(ii) Addition of matrices is associative: $(A+B)+C = A+(B+C)$

(iii) Existance of additive identity: $A+0 = 0+A = A$
The null matrix 0 is the additive identity.

(iv) Existence of additive inverse: $A+(-A) = 0$ and $(-A)+A = 0$

The matrix '$-A$' is called the additive inverse of matrix A

(v) Existence of a scalar multiplication: $K(A+B) = KA+KB$ where K denotes scalar