Types of Matrix

2nd Sem (m)

(7) **Transpose of a Matrix:-** when the rows and columns of a Matrix A are interchanged - so that its first row becomes the first column and vice-versa - we obtain the transpose of A, which is denoted by A'. For example,

(i) $A = \begin{bmatrix} 3 & 8 & -9 \\ 1 & 0 & 4 \end{bmatrix}_{2\times 3}$ $\therefore A' = \begin{bmatrix} 3 & 1 \\ 8 & 0 \\ -9 & 4 \end{bmatrix}_{3\times 2}$

(ii) $B = \begin{bmatrix} 3 & -4 \\ -1 & 7 \end{bmatrix}_{2\times 2}$ $\therefore B' = \begin{bmatrix} 3 & -1 \\ -4 & 7 \end{bmatrix}_{2\times 2}$

By definition, if a matrix A is $m\times n$, then its transpose A' must be $n\times m$. An $n\times n$ square matrix possesses a transpose with the same dimension.

(8) **Square Matrix:-** A matrix having the same numbers of rows as it has columns is called a square matrix. For example,

(i) $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}_{2\times 2}$ (ii) $B = \begin{bmatrix} 1 & 0 & 4 \\ 0 & 3 & 7 \\ 4 & 6 & 2 \end{bmatrix}_{3\times 3}$

(9) **Diagonal Matrix:-** A square matrix having all the elements zero except the principal diagonal elements, is called a diagonal matrix. For example,

(i) $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}_{2\times 2}$ $B = \begin{bmatrix} 2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 3 \end{bmatrix}_{3\times 3}$

(10) Identity Matrix (or unit Matrix) :- A square matrix in which each diagonal elements are one, all other elements being zero is called a unit or identity matrix, it is denoted by I. For example,

(i) $I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}_{2\times 2}$ (ii) $I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}_{3\times 3}$

(11) Scalar Matrix :- A square matrix whose all elements except those in the main diagonal are zero and the diagonal elements are all equal is called a scalar matrix. For example,

(i) $A = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}_{2\times 2}$ (ii) $B = \begin{bmatrix} 10 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 10 \end{bmatrix}_{3\times 3}$

(12) Symmetric Matrix :- A square matrix $A=(a_{ij})$ is said to be symmetric if $a_{ij} = a_{ji}$ for all i and j on both sides of the diagonal

i.e if $a_{12} = a_{21}$, $a_{13} = a_{31}$, $a_{23} = a_{32}$ etc,

For example,

(i) $A = \begin{bmatrix} a & g \\ g & a \end{bmatrix}_{2\times 2}$ (ii) $B = \begin{bmatrix} 2 & 6 & -3 \\ 6 & 3 & 7 \\ -3 & 7 & 4 \end{bmatrix}_{3\times 3}$

(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:-

(i) $\begin{bmatrix} 0 & -2 & -4 \\ 2 & 0 & -5 \\ 4 & 5 & 0 \end{bmatrix}_{3\times3}$ (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 ~~ted~~ reproduces itself as a result of multiplied by itself. For example;

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

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

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

$\therefore B^2 = B$