MATRIX

**Matrix**: A matrix is a rectangular arrangement of numbers or mathematical expressions.

e.g. A = , B = , C = , D = 

Order of The Matrix: The order refers to the dimensions of a matrix. A matrix having m rows and n columns is said to have an order of m × n.

e.g. In the above examples of matrices, A, B and C have 2 × 2, 3 × 3 and 3 × 3 order while D has 2 × 3 order.

**Types of Matrices:**

1. **Row Matrix**: A matrix having only 1 row is called a row matrix.

e.g. A = 

1. **Column Matrix**: A matrix having only 1 column is called a column matrix.

e.g. B = 

1. **Square matrix**: A matrix having equal number of column and rows is called a square matrix.

e.g. A = , B = , C =

All these matrices are examples of square matrix.

1. **Rectangle Matrix**: A matrix having unequal number of columns and rows is called a rectangular matrix.

e.g. A = , B = 

The sum of the principle diagonal elements of a square matrix is called the **Trace** of the matrix.

1. **Identity Matrix:** A square matrix havingall principal diagonals as 1 and other elements as 0 is called identity matrix. It is represented by In×n.

e.g. I3×3 = .

1. **Idempotent Matrix:** A square matrix is called idempotent if the product of the matrix with itself results in the same matrix.

e.g. Identity matrix.

Results:

If A is an idempotent matrix, A = A2. In general, A = An

1. **Scalar Matrix:** A diagonal matrix in which all elements of the leading diagonal are equal.

e.g.

1. **Unit Matrix:** A diagonal matrix in which all elements of the leading diagonal are an equal one.

e.g.

1. **Null Matrix:** A matrix in which all elements are zero.

e.g.

1. **Symmetric Matrix:** A matrix in which the element of the ith row and jth column is equal to the element of the jth row and ith column.

e.g.

(k) **Skew-symmetric Matrix:** A matrix in which the element of the ith row and jth column is equal to the negative of the element of the jth row and ith column, such that all elements of the principle diagonal are zero.

e.g.

(l) **Triangular Matrix:**

1. **Upper** **triangular Matrix**: A matrix in which all elements below the principle diagonal are zero.

e.g.

1. **Lower triangular Matrix**: A matrix in which all elements above the principle diagonal are zero.

e.g.

**Algebra of Matrices**

 (a) **Elementary Transformations of a matrix**

(i)Interchange of rows/columns

(ii) Multiplication of a row or column by a non-zero number.

(iii) The addition/subtraction of a constant multiple of the elements of any row (or column) to the corresponding elements of any other row (or column)

(b) **Equivalent Matrices:** Two matrices are said to be equivalent if one of the matrices can be obtained by elementary transformations on the other.

(c**) Equal Matrices:** Two matrices are said to be equal if and only if

(i) The order of the matrices is same

(ii) The corresponding elements of matrices are equal

(d) **Addition / Subtraction of Matrices**: Two matrices can be added/subtracted if and only if the order of the matrices is same. The resultant matrix is the addition/subtraction of the corresponding elements.

(e) **Multiplication of a matrix and a scalar**: When a scalar is multiplied to a matrix, the product is the scalar-multiplied to each of the corresponding elements of the matrix.

e.g. 5 × =

(f) **Multiplication of two matrices**: Two matrices can be multiplied if and only if the number of rows in the first matrix is equal to the number of columns in the second matrix.

Note: It is not necessary that if two matrices X and Y are multiplied then XY =YX.

(g) **Transpose of a matrix**

The transpose of a given matrix is the matrix obtained by interchanging the elements of rows and columns.

e.g. A = then AT =

For a Symmetric matrix: X = XT while for a Skew-symmetric matrix: X= - XT

Note:

(i) The transpose of a product of the two matrices is taken in reverse order i.e. (XY)T=YTXT

(ii) Any square matrix can be expressed as the sum of a symmetric matrix and skew-symmetric matrix.

X = ½(X+XT) + ½(X-XT)

Here, ½(X+XT) is a symmetric matrix while ½(X-XT) is a skew-symmetric matrix.