BAL BHARATI PUBLIC SCHOOL, PITAMPURA, DELHI – 110034

Class XII
SUBJECT:- MATHEMATICS
CHAPTER:-3 MATRICES

STEP 1:- Watch the videos to understand what are Matrices.
https://youtu.be/7vnfRPzAQ0g
https://youtu.be/JMjbPh1Mjn8

STEP 2:- Watch the video to understand what are Elements of a matrix, what is order and position of an Element in a matrix.

https://youtu.be/F37rd-BpVOo

STEP 3:- Watch the video to understand when are 2 or more matrices equal.
https://youtu.be/NjaQKHIntGE

STEP 4 :- Watch the videos to understand what are different types of matrices.
https://youtu.be/alc9i7V2e9Q
https://youtu.be/nfG4NwLhH14

Try exercise 3.1 NCERT and examples of it.

STEP 5 :- Watch the videos to understand addition, subtraction and scalar multiplication of matrices.
https://youtu.be/ZCmVpGv6_1g
https://youtu.be/7jb_AO_hRc8
https://youtu.be/4lHyTQH1iS8

STEP 6 :- Watch the videos to understand the multiplication of two or more matrices.
https://youtu.be/o6tGHLkZvVM
https://youtu.be/o6tGHLkZvVM
https://youtu.be/-8ST0y82yXg

Try exercise 3.2 NCERT and examples of it.

STEP 7 :- Watch the video to understand what is Transpose of a matrix.
https://youtu.be/g_Rz94DXvNo

STEP 8 : - Watch the videos to understand what are symmetric & skew symmetric matrices.
https://youtu.be/IBgXO5qvbrg
https://youtu.be/uKPmyG18N7I

Try exercise 3.3 NCERT & examples of it.

STEP 8 : - Watch the videos to understand what is identity matrix and inverse of a matrix,
https://youtu.be/iks8wCfPerU
https://youtu.be/AMLUikdDQGk

Try exercise 3.4 + miscellaneous and examples of it.

SUMMARY:

1. **A matrix is a rectangular arrangement of numbers (real or complex)**
2. **A matrix is enclosed by [ ].**
3. **a_{11}, a_{12} … etc., in the above matrix are known as the element of the matrix, generally represented as a_{ij}, which denotes element in i^{th} row and jcolumn.**
4. **If a matrix has m rows and n columns, then matrix A is of order m x n.**
5. **Two matrices A and B are said to be equal, if both having same order and corresponding elements of the matrices are equal.**
6. **Let A and B be two matrices each of order m x n. Then, the sum of matrices A + B is defined only if matrices A and B are of same order.**

   If $A = [a_{ij}]_{m \times n}$, $A = [a_{ij}]_{m \times n}$

   Then, $A + B = [a_{ij} + b_{ij}]_{m \times n}$

   Properties of Addition of Matrices If A, B and C are three matrices of order m x n, then

   1. **Commutative Law** $A + B = B + A$
   2. **Associative Law** $(A + B) + C = A + (B + C)$
   3. **Existence of Additive Identity** A zero matrix (0) of order m x n (same as of A), is additive identity, if
      $A + 0 = A = 0 + A$
   4. **Existence of Additive Inverse** If A is a square matrix, then the matrix (- A) is called additive inverse, if
      $A + (- A) = 0 = (- A) + A$

   5. **Cancellation Law**
      $A + B = A + C \Rightarrow B = C$ (left cancellation law)
      $B + A = C + A \Rightarrow B = C$ (right cancellation law)

7. **Let A and B be two matrices of the same order, then subtraction of matrices, A – B, is defined as**
   $A - B = [a_{ij} - b_{ij}]_{m \times n}$
   Where $A = [a_{ij}]_{m \times n}$ & $B = [b_{ij}]_{m \times n}$
8. **Let $A = [a_{ij}]_{m \times n}$ be a matrix and k be any scalar. Then, the matrix obtained by multiplying each element of A by k is called the scalar multiple of A by k and is denoted by kA, given as $kA= [k\, a_{ij}]_{m \times n}$**

   Properties of Scalar Multiplication If A and B are matrices of order m x n, then

   1. $k(A + B) = kA + kB$
   2. $(k_1 + k_2)A = k_1A + k_2A$
   3. $k_1k_2A = k_1(k_2A) = k_2(k_1A)$
   4. $(- k)A = -(kA) = k(-A)$

9. **Multiplication of Matrices**

Let $A = [a_{ij}]_{m \times n}$ and $B = [b_{ij}]_{n \times p}$ are two matrices such that the number of columns of A is equal to the number of rows of B, then multiplication of A and B is denoted by AB, is given by

$$c_{ij} = \sum_{k=1}^{n} a_{ik} b_{kj} ,$$

where c_{ij} is the element of matrix C and C = AB

Properties of Multiplication of Matrices

1. Commutative Law Generally $AB \neq BA$
2. Associative Law $(AB)C = A(BC)$
3. Existence of multiplicative Identity $A.I = A = I.A$,
   I is called multiplicative Identity.
4. Distributive Law $A(B + C) = AB + AC$

10. **In the matrix product AB, the matrix A is called premultiplier (prefactor) and B is called postmultiplier (postfactor).**

11. **The rule of multiplication of matrices is row column wise (or → ↓ wise) the first row of AB is obtained by multiplying the first row of A with first, second, third,… columns of B respectively; similarly second row of A with first, second, third, … columns of B, respectively and so on.**

12. **Properties of exponents :**

Let A be a square matrix. Then, we can define

1. $A^{n+1} = A^n . A$, where $n \in N$.
2. $A^m . A^n = A^{m+n}$
3. $(A^m)^n = A^{mn}, \forall m, n \in N$

13. **Let $A = [a_{ij}]_{m \times n}$, be a matrix of order m x n. Then, the n x m matrix obtained by interchanging the rows and columns of A is called the transpose of A and is denoted by A' or A^T.**

$A' = A^T = [a_{ij}]_{n \times m}$

Properties of Transpose

1. $(A')' = A$
2. $(A + B)' = A' + B'$
3. $(AB)' = B'A'$
4. $(KA)' = kA'$
5. $(A^N)' = (A')^N$
6. $(ABC)' = C' B' A'$

14. **A square matrix $A = [a_{ij}]_{n \times n}$, is said to be symmetric, if A' = A. i.e., $a_{ij} = a_{ji}$, ∀ i and j.**

15. **A square matrix A is said to be skew-symmetric matrices, if i.e., $a_{ij} = - a_{ji}$, ∀ i and j.**

16. **Elements of principal diagonals of a skew-symmetric matrix are all zero. i.e.,**

$a_{ii} = - a_{ii}$

$2 a_{ii} = 0$ or $a_{ii} = 0$, for all values of i.

17. **If A is a square matrix, then**

(a) A + A' is symmetric.

(b) A — A' is skew-symmetric matrix.

If A and B are two symmetric (or skew-symmetric) matrices of same order, then A + B is also symmetric (or skew-symmetric).

If A is symmetric (or skew-symmetric), then kA (k is a scalar) is also symmetric for skew-symmetric matrix.

If A and B are symmetric matrices of the same order, then the product AB is symmetric, iff BA = AB.

Every square matrix can be expressed uniquely as the sum of a symmetric and a skew symmetric matrix.

The matrix B' AB is symmetric or skew-symmetric according as A is symmetric or skew-symmetric matrix.

All positive integral powers of a symmetric matrix are symmetric.

All positive odd integral powers of a skew-symmetric matrix are skew-symmetric and positive even integral powers of a skew-symmetric are symmetric matrix.

If A and B are symmetric matrices of the same order, then

(a) AB – BA is a skew-symmetric

(b) AB + BA is symmetric.

For a square matrix A, AA' and A' A are symmetric matrix.

18. **Any one of the following operations on a matrix is called an elementary transformation.**

    1. Interchanging any two rows (or columns), denoted by $R_i \leftrightarrow R_j$ or $C_i \leftrightarrow C_j$

    2. Multiplication of the element of any row (or column) by a non-zero quantity and denoted by $R_i \rightarrow kR_i$ or $C_i \rightarrow kC_j$

    3. Addition of constant multiple of the elements of any row to the corresponding element of any other row, denoted by $R_i \rightarrow R_i + kR_j$ or $C_i \rightarrow C_i + kC_j$

19. **Inverse of a matrix if it exists is unique.**