CLASS 12 MATHEMATICS — FORMULA SHEET

Chapter 3 : Matrices (NCERT)

3.1 Basics & Order of a Matrix

Concept	Detail
Matrix	Rectangular array of numbers arranged in rows & columns
Order	m × n (m rows, n columns)
Element a_{ij}	Entry in i-th row, j-th column
Number of elements	m × n
Equal matrices	Same order AND corresponding elements equal
Number of m×n matrices	Possible with given entries set

3.2 Types of Matrices

Type	Definition
Row matrix	Single row (1 × n)
Column matrix	Single column (m × 1)
Square matrix	Rows = columns (n × n)
Diagonal matrix	Non-diagonal elements all zero
Scalar matrix	Diagonal matrix with equal diagonal elements
Identity matrix (I)	Scalar matrix with diagonal elements = 1
Zero matrix	All elements zero
Upper/lower triangular	Zeros below/above the main diagonal

3.3 Matrix Operations

Operation	Rule
Addition	Add corresponding elements (same order required)
Scalar multiplication	Multiply every element by the scalar k
Multiplication condition	A(m×n) × B(n×p) defined only if columns of A = rows of B
Product order	Result is (m × p)
AB ≠ BA	Matrix multiplication is NOT commutative (in general)
Associative	(AB)C = A(BC)
Distributive	A(B + C) = AB + AC
Identity property	AI = IA = A

3.4 Transpose of a Matrix

Property	Formula
Transpose A'	Rows become columns (interchange)
(A')'	= A
(A + B)'	= A' + B'
(kA)'	= k A'
(AB)'	= B' A' (order reverses)
Symmetric matrix	A' = A ($a_{ij} = a_{ji}$)
Skew-symmetric matrix	A' = −A (diagonal elements = 0)

3.5 Symmetric & Skew-Symmetric

Concept	Detail
Symmetric	A' = A
Skew-symmetric	A' = −A ; main diagonal all zeros
Any square matrix	A = (symmetric part) + (skew-symmetric part)
Symmetric part	½(A + A')
Skew-symmetric part	½(A − A')
A + A'	Always symmetric
A − A'	Always skew-symmetric

3.6 Elementary Operations & Invertible Matrices

Concept	Detail
Elementary row operations	Swap rows, scale a row, add a multiple of one row to another
Invertible matrix	A is invertible if there exists B with AB = BA = I
Inverse notation	$B = A^{-1}$
Inverse uniqueness	Inverse of a matrix, if it exists, is unique
$(AB)^{-1}$	$= B^{-1} A^{-1}$ (order reverses)
Inverse by elementary ops	Convert A to I via row ops applied also to I
Condition to be invertible	Square matrix with non-zero determinant (covered in Ch 4)

★ QUICK MEMORY AIDS & TRICKS

Multiplication rule	AB defined only when columns of A = rows of B. Result is rows(A) × cols(B).
Not commutative	AB ≠ BA in general — order always matters with matrices.
Transpose reverses	(AB)' = B'A' and $(AB)^{-1} = B^{-1}A^{-1}$ — order flips.
Symmetric vs skew	Symmetric: A' = A. Skew: A' = −A (diagonal all zeros).
Decomposition	Any square matrix = ½(A+A') + ½(A−A') (symmetric + skew parts).

Identity	$AI = IA = A$. The identity matrix acts like '1' for matrices.
Zero product trap	$AB = 0$ does NOT mean $A = 0$ or $B = 0$ (unlike numbers).
Inverse needs square	Only square matrices can have inverses ; and only if $\det \neq 0$.