

ADHIKAANSH ACADEMY (IITJEE NEET IX X XI XII)

RUN BY:

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MATHS NOTES (CLASS 12TH)



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Key Notes

Chapter-4

Determinant

- Determinant of a matrix $A = [a_{ij}]_{n \times n}$ is given by $|a_{11}| = a_{11}$
- Determinant of a matrix $A \begin{matrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{matrix}$ is given by

$$|A| = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11} a_{22} - a_{12} a_{21}$$

- Determinant of a matrix $A \begin{matrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{matrix}$ is given by (expanding along (R_1))

$$|A| = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

- **For any square matrix A, the |A| satisfy following properties.**
 - $|A'| = |A|$, where A' = transpose of A.
 - If we interchange any two rows (or columns), then sign of determinant changes.
 - If any two rows or any two columns are identical or proportional, then value of determinant is zero.
 - If we multiply each element of a row or a column of a determinant by constant k, then value of determinant is multiplied by k.
 - Multiplying a determinant by k means multiply elements of only one row (or one column) by k.
 - If $A = [a_{ij}]_{3 \times 3}$, then $|k \cdot A| = k^3 |A|$
 - If elements of a row or a column in a determinant can be expressed as sum of two or more elements, then the given determinant can be expressed as sum of two or more determinants.
-

Key Notes

- If to each element of a row or a column of a determinant the equimultiples of corresponding elements of other rows or columns are added, then value of determinant remains same.
- Area of a triangle with vertices (x_1, y_1) , (x_2, y_2) and (x_3, y_3) is given by

$$\Delta = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

- Minor of an element a_{ij} of the determinant of matrix A is the determinant obtained by deleting i^{th} row and j^{th} column and denoted by M_{ij}
 - Cofactor of a_{ij} is given by $A_{ij} = (-1)^{i+j} M_{ij}$
 - Value of determinant of a matrix A is obtained by sum of product of elements of a row (or a column) with corresponding cofactors. For example, $|A| = a_{11} A_{11} + a_{12} A_{12} + a_{13} A_{13}$.
 - If elements of one row (or column) are multiplied with cofactors of elements of any other row (or column), then their sum is zero. For example, $a_{11} A_{21} + a_{12} A_{22} + a_{13} A_{23} = 0$
 - $A (\text{adj } A) = (\text{adj } A) A = |A| I$, where A is square matrix of order n.
 - A square matrix A is said to be singular or non-singular according as $|A| = 0$ or $|A| \neq 0$.
 - If $AB = BA = I$, where B is square matrix, then B is called inverse of A. Also $A^{-1} = B$ or $B^{-1} = A$ and hence $(A^{-1})^{-1} = A$.
 - A square matrix A has inverse if and only if A is non-singular.
 - $A^{-1} = \frac{1}{|A|} (\text{adj } A)$
 - If $a_1x + b_1y + c_1z = d_1$
 - $a_2x + b_2y + c_2z = d_2$
 - $a_3x + b_3y + c_3z = d_3$
 - then these equations can be written as $AX = B$, where
-

Key Notes

$$A = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} = X \begin{bmatrix} x \\ y \\ z \end{bmatrix} \text{ and } B = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

- Unique solution of equation $AX = B$ is given by $X = A^{-1}B$, where $|A| \neq 0$.
 - A system of equation is consistent or inconsistent according as its solution exists or not.
 - For a square matrix A in matrix equation $AX = B$
 - $|A| \neq 0$, there exists unique solution
 - $|A| = 0$ and $(\text{adj } A) B \neq 0$, then there exists no solution
 - $|A| = 0$ and $(\text{adj } A) B = 0$, then system may or may not be consistent.
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