BINOMIAL THEOREM

1. **Binomial Theorem for Positive Integral Indices**

2. **General and Middle Terms**

- **Binomial Theorem**: The expansion of a binomial for any positive integral n is given by Binomial Theorem, which is $(a+b)^n = {}^nC_0 a^n + {}^nC_1 a^{n-1} b + {}^nC_2 a^{n-2} b^2 + \ldots + {}^nC_{n-1} a b^{n-1} + {}^nC_n b^n$.
- The coefficients of the expansions are arranged in an array. This array is called *Pascal's triangle.*
- The general term of an expansion $(\mathrm{a}+\mathrm{b})^n$ $is\ T_{r+1} = {}^nC_r a^n b^r$.
- The general term of an expansion $(a-b)^n = (-1)^r . {}^n\mathrm{C}_r . a^{n-r} .\ b^r$
- The general term of $(1+x)^n = {}^n\mathrm{C}_r . x^r$
- The general term of $(1-x)^n = (-1)^r . {}^n\mathrm{C}_r . x^r$
- In the expansion $(\mathrm{a}+\mathrm{b})^n$, if n is even, then the middle term is the $\left(\frac{n}{2}+1\right)^{th}$ term. If n is odd, then the middle terms are $\left(\frac{n}{2}+1\right)^{th}$ and $\left(\frac{n+1}{2}+1\right)^{th}$ terms.
- r^{th} term from the end in $(a+b)^n = (n+2-r)^{tn}$ term fromt hebeginning.
- Method to prove Binomial Theorem:

(a) Principle of Mathematical Induction.

(b) Combinatorial Method.

- Factorial notation:
  (i) $n! = 1 \times 2 \times 3 \times 4 \ldots\ldots \times n; \quad 0! = 1$
  (ii) ${}^n\mathrm{C}_r = \frac{n!}{r!(n-r)!}$
  (iii) ${}^n\mathrm{C}_r = {}^n\mathrm{C}_{n-r}$
  (iv) ${}^n\mathrm{C}_r + {}^n\mathrm{C}_{r\_1} = {}^{n+1}\mathrm{C}_r$