IMPORTANT JEE-NEET FORMULAS

Binomial Theorem Formula's

- **Binomial Theorem for positive Integral Index:**
  $(x+a)^n = {}^nC_0 x^n a^0 + {}^nC_1 x^{n-1} a + {}^nC_2 x^{n-2} a^2 + \cdots + {}^nC_r x^{n-r} a^r + \cdots + {}^nC_n . x a^n$

- **General Term:** $T_{r+1} = {}^nC_r x^{n-r} a^r$

- **Deductions of Binomial Theorem:**
  i. $(1+x)^n = {}^nC_0 + {}^nC_1 x + {}^nC_2 x^2 + {}^nC_3 x^3 + \cdots + {}^nC_r x^r + \cdots + {}^nC_n x^n$ which is the standard form of binomial expansion.
  General Term= $(r+1)^{th}$ term: $T_{r+1} = {}^nC_r x^r = \frac{n(n-1)(n-2)......(n-r+1)}{r!} . x^r$

  ii. $(1-x)^n = {}^nC_0 - {}^nC_1 x + {}^nC_2 x^2 - {}^nC_3 x^3 + \cdots + (-1)^r {}^nC_r x^r + \cdots + (-1)^n {}^nC_n x^n$
  General Term= $(r+1)^{th}$ term: $T_{r+1} = (-1)^r . {}^nC_r x^r = \frac{n(n-1)(n-2)......(n-r+1)}{r!} . x^r$

- **Middle Term in the expansion of $(x+a)^n$:**
  i. If n is even then middle term $= \left(\frac{n}{2}+1\right)^{th}$ term.
  ii. If n is odd then middle terms are $\left(\frac{n+1}{2}\right)^{th}$ and $\left(\frac{n+3}{2}\right)^{th}$ term.
  iii. Binomial coefficients of middle term is the greatest Binomial coefficients

- **To determine a particular term in the expansion:**
  In the expansion of $\left(x^\alpha \pm \frac{1}{x^\beta}\right)^n$, if x^m occurs in T_{r+1}, then r is given by
  $n\alpha - r(\alpha+\beta) = m \Rightarrow r = \frac{n\alpha - m}{\alpha+\beta}$ and the term which is independent of x then
  $n\alpha - r(\alpha+\beta) = 0 \Rightarrow r = \frac{n\alpha}{\alpha+\beta}$.

- **To find a term from the end in the expansion of $(x+a)^n$:** $T_r(E) = T_{n-r+2}(B)$

- **Binomial Coefficients and their properties:**
  In the expansion of $(1+x)^n = C_0 + C_1 x + C_2 x^2 + \cdots + C_r x^r + \cdots + C_n x^n$
  Where $C_0 = 1, C_1 = n, C_2 = \frac{n(n-1)}{2!}$

  i. $C_0 + C_1 + C_2 + ... + C_n = 2^n$

ii. $C_0 - C_1 + C_2 - C_3 + \ldots\ldots = 0$

iii. $C_0 + C_2 + \ldots\ldots = C_1 + C_3 + \ldots\ldots = 2^{n-1}$

iv. $C_0^2 + C_1^2 + C_2^2 + \ldots\ldots + C_n^2 = \frac{2n!}{n!n!}$

v. $C_0 + \frac{C_1}{2} + \frac{C_2}{3} + \ldots\ldots + \frac{C_n}{n+1} = \frac{2^{n+1}-1}{n+1}$

vi. $C_0 - \frac{C_1}{2} + \frac{C_2}{3} - \frac{C_3}{4} + \ldots\ldots + \frac{(-1)^n . C_n}{n+1} = \frac{1}{n+1}$

- **Greatest term in the expansion of $(x+a)^n$:**
  i. The term in the expansion of $(x+a)^n$ of greatest coefficients

$$= \begin{cases} T_{\frac{(n+2)}{2}}, & when\ n\ is\ even \\ T_{\frac{(n+1)}{2}}, \quad T_{\frac{(n+3)}{2}} & when\ n\ is\ odd \end{cases}$$

  ii. The greatest term =

$$\begin{cases} T_p , T_{p+1}, \ when\ \frac{(n+1)a}{x+a} = p \in Z \\ T_{q+1}, \ When\ \frac{(n+1)a}{x+1}\ not\ belong\ to\ Z\ and\ q < \frac{(n+1)a}{x+a} < q+1 \end{cases}$$

- **Multinomial Expansion:** If $n \in N$ then the general terms of multinomial expansion $(x_1 + x_2 + x_3 + \ldots\ldots + x_k)\hat{}n$ is $\sum_{r_1+r_2+\cdots+r_k=n} \frac{n!}{r_1!r_2!\ldots r_k!} x_1^{r1} . x_2^{r2} \ldots x_k^{r_k}$

- **Binomial Theorem for Negative Integer Or Fractional Indices:**

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + \cdots$$
$$+ \frac{n(n-1)(n-2)\ldots\ldots(n-r+1)}{r!}x^r + \cdots, |x| < 1$$
$$T_{r+1} = \frac{n(n-1)(n-2)\ldots\ldots(n-r+1)}{r!}x^r$$