CHAPTER – 2
POLYNOMIALS

1. Polynomials in one Variable
2. Zeroes of a Polynomial
3. Remainder Theorem
4. Factorisation of Polynomials
5. Algebraic Identities

- **Constants**: A symbol having a fixed numerical value is called a constant.
- **Variables**: A symbol which may be assigned different numerical values is known as variable.
- **Algebraic expressions**: A combination of constants and variables. Connected by some or all of the operations +, -, X and is known as algebraic expression.
- **Terms:** The several parts of an algebraic expression separated by '+' or '-' operations are called the terms of the expression.
- **Polynomials:** An algebraic expression in which the variables involved have only non-negative integral powers is called a polynomial.

  (i) $5x^2 - 4x^2 - 6x - 3$ is a polynomial in variable x.

  (ii) (ii) $5 + 8x^{\frac{3}{2}} + 4x^{-2}$ is an expression but not a polynomial.

  Polynomials are denoted by p(x), q(x) and r(x)etc.
- **Coefficients**: In the polynomial $x^3 + 3x^2 + 3x + 1$, coefficient of x^3, x^2, x are $1, 3, 3$ respectively and we also say that +1 is the constant term in it.
- Degree of a polynomial in one variable: In case of a polynomial in one variable the highest power of the variable is called the degree of the polynomial.
- Classification of polynomials on the basis of degree.

Degree	Polynomial	Example
(a) 1	Linear	$+1, 2x+3$et
(b) 2	Quadratic	$ax^2 + bx + c$ etc.
(c) 3	Cubic	$x^3 + 3x^2 + 1$ etc. etc.
(d) 4	Biquadratic	$x^4 - 1$

Classification of polynomials on the basis of no. of terms

No. of terms		Polynomial & Examples.
(i)	1	Monomial - $\frac{1}{3}$,
(ii)	2	Binomial - $(3+6x), (x-5y)$ etc.
(iii)	3	Trinomial- $2x^2+4x+2$ etc. etc.

- **Constant polynomial**: A polynomial containing one term only, consisting a constant term is called a constant polynomial the degree of non-zero constant polynomial is zero.
- **Zero polynomial**: A polynomial consisting of one term, namely zero only is called a zero polynomial. The degree of zero polynomial is not defined.
- **Zeroes of a polynomial**: Let $p(x)$ be a polynomial. If $\alpha)=0$, then we say that is a zero of the polynomial of p(x).
- **Remark:** Finding the zeroes of polynomial p(x) means solving the equation p(x)=0.
- **Remainder theorem:** Let $f(x)$ be a polynomial of degree ≥ 1 and let a be any real number. When f(x) is divided by $-a)$ then the remainder is f (a)
- **Factor theorem:** Let $f(x)$ be a polynomial of degree n > 1 and let a be any real number.
  (i) If $f(a)=0$ then $(x-a)$ is factor of $f(x)$
  (ii) If $(x-a)$ is factor of $f(x)$then $f(a)=0$
- **Factor:** A polynomial $p(x)$ is called factor of $q(x)$ divides $q(x)$ exactly.
- **Factorization**: To express a given polynomial as the product of polynomials each of degree less than that of the given polynomial such that no such a factor has a factor of lower degree, is called factorization.

Some algebraic identities useful in factorization:

(i) $(x+y)^2 = x^2+2xy+y^2$

(ii) $(x-y)^2 = x^2-2xy+y^2$

(iii) $x^2-y^2=(x-y)(x+y)$

(iv) $(x+a)(x+b) = x^2+(a+b)x+ab$

(v) $(x+y+z)^2 = x^2+y^2+z^2+2xy+2yz+2zx$

(vi) $(x+y)^3 = x^3+y^3+3xy(x+y)$

(vii) $(x-y)^3 = x^3-y^3-3xy(x-y)$

(viii) $x^3+y^3+z^3-3xyz = (x+y+z)(x^2+y^2+z^2-xy-yz-zx)$

$x^3+y^3+z^3=3xyz \quad if \;\; x+y+z=0$