Classification of Polymers :-

1) Based on ~~Origin~~ Based on Origin

- **Natural**
  - Obtained from Nature (Plant & Animals)
  - Eg :- Starch, cellulose, natural rubber
- **Synthetic**
  - Prepared in laboratory (Artificial)
  - Eg :- PVC, PMMA

2) Based on Chemical Structure

- **Homopolymer**
  - Monomers are same/identical
  - Eg :- Polymers formed by Addition Polymerization
- **Co-polymer / Heteropolymer**
  - Monomers are different
  - Eg :- Polymers formed by Condensation and Co-polymerization

3) Based on Functionality → no. of reactive site in monomers is functionality

- **Bifunctional / linear / straight chain**
  - (i) Monomers attached in straight manner
  - (ii) Well packed
  - (iii) High • Melting point
    • Tensile strength
    • Density
  - Eg :- Polyethene, Polystyrene
- **Trifunctional / Branched chain**
  - (i) Monomers attached in branched manner
  - (ii) Gapping present
  - (iii) Low • Melting point
    • Tensile strength
    • Density
  - Eg :- Glycogen, starch
- **Polyfunctional / Cross linked / network**
  - (i) Monomers attached in zigzag manner
  - (ii) 3D structure
  - (iii) hard, brittle and rigid.
  - Eg :- Bakelite, Melamine

4) Based on Mode of Synthesis

Addition Polymer

i) Polymers obtained by Addition Polymerization
ii) Empirical formula is same as monomer
iii) No elimination of small molecules

Eg:- i) Polyvinyl chloride (PVC)
2) Polymethyl methacrylate (PMMA)
3) Polyethene (PE)
4) Polystyrene (PS)

Condensation Polymer

i) Polymers obtained by Condensation Polymerization
ii) Empirical formula is different from monomer
iii) Elimination of small molecules like H_2O, HCl, NH_3 etc

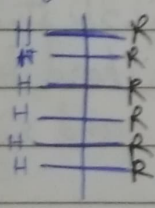
Eg:- 1) Nylon-6
2) Nylon-6,6
3) Bakelite
4) Melamine

5) Based on Tacticity

Isotactic

All functional groups attached on same side of chain

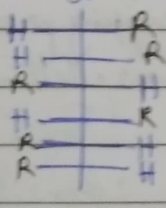
Eg:- Glucose



Atactic

All functional groups attached on random sides of chain

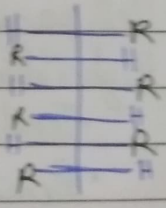
Eg:- Polypropylene



Syndiotactic

All functional groups attached along chain in alternate manner

Eg:- Gutta percha



The orientation of monomer units in polymer takes place in orderly / disorderly manner w.r.t main chain

This difference in configuration → Tacticity

6) Based on Inter-Molecular Forces

	Elastomers	Fibre	Thermoplastic (physical changes occur only)	Thermosetting (chemical changes occur only)
Elasticity	• high elasticity	• low elasticity	• low elasticity	• low elasticity
Tensile strength	• Poor tensile strength	• High tensile strength	• High tensile strength	• High tensile strength
Force of interaction	• weak forces of attraction	• high forces of attraction	• high forces of attraction	• very high forces of attraction
Stress	• Regains original shape & size (after stress removed)	• Long, thin thread like, so they can be woven	• becomes soft on heating, hard on cooling, so they can be reshaped	• After heating, it becomes hard & brittle.
	Eg:- Rubber	Eg:- Nylon	Eg:- PVC	Eg:- ~~PHHP~~ PF

In terms of strength of interaction forces,

Elastomers < Fibre < Thermoplastic < Thermosetting

(*) In thermoplastic, only physical changes occur

In Thermosetting, chemical changes lead to permanent change

Thermoplastic (Eg:- PVC, PMMA) [PMMA → polymethyl methacrylate]	V/S	Thermosetting (Eg:- PF, MF) [PF → phenol formaldehyde, MF → melamine]
1) Formed by addition/condensation		1) Formed by only condensation
2) Linear/Branched [Bi/Trifunctional]		2) 3D/Cross linked [Polyfunctional]
3) Vander-waal/hydrogen bonds		3) Strong covalent bonds
4) Soften on heating, stiffen on cooling		4) Do not soften on heating
5) Can be reshaped		5) Cannot be reshaped
6) They are tough material		6) They are brittle materials