

## UNIT IV –Polymer and Composites

### 1. What are polymers?

Polymers are materials of very high molecular weight that have many applications in the modern society. Polymers are obtained through the combination of small molecules called monomers.

For example, polyethylene is formed from the monomer ethylene

### 2. What is polymerization?

**Polymerization** is the chemical process in which many small molecules, called **monomers**, combine to form a large macromolecule, known as a **polymer**. This process can occur through various mechanisms, such as addition polymerization or condensation polymerization.

### 3. Classify polymers based on origin with examples.

#### 1. Natural Polymers

These are polymers that occur naturally in plants, animals, and other organisms.

- Examples:

- Cellulose (found in plants)
- Proteins (e.g., silk, keratin)
- Natural rubber (from latex of rubber trees)

#### 2. Synthetic Polymers

These are man-made polymers produced through chemical processes.

- Examples:

- Polyethylene (used in packaging)
- Nylon (used in textiles)
- Teflon (used as a non-stick coating)

#### 3. Semi-Synthetic Polymers

These are derived from natural polymers but chemically modified to enhance their properties.

- Examples:

- Cellulose acetate (used in films and textiles)
- Vulcanized rubber (used in tires).

### 4. Differentiate between homopolymers and copolymers.

Feature	Homopolymers	Copolymers
Definition	Polymers made from only one type of monomer	Polymers made from two or more different monomers
Structure	Uniform and simple repeating units	Complex repeating units with alternating, random, or block arrangements.
Example	Polyethylene (from ethylene monomers).	Nylon-6,6 (from hexamethylenediamine and adipic acid).

**5. Give two examples of natural polymers.**

**Cellulose:** Found in the cell walls of plants, used in making paper and textiles.

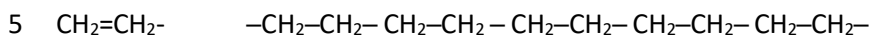
**Proteins:** Such as keratin (in hair and nails) and collagen (in connective tissues).

**6. What is the degree of polymerization?**

The number of repeating units present in a polymer is called degree of polymerization

Degree of polymerization: 
$$\frac{\text{Molecular weight of the Polymeric Network}}{\text{Molecular weight of the Monomeric Unit}}$$

Here n is the degree of polymerization.



In this example, five repeating units are present in the polymer chain, So the degree of polymerization is 5

**7. Name two physical properties of polymers.**

**Tensile Strength:** Polymers can stretch under stress, which makes them suitable for applications like rubber bands and plastic films.

**Thermal Stability:** Polymers have varying heat resistance; for example, thermoplastics soften when heated, while thermosetting plastics remain stable under high temperatures.

**8. Name two applications of polymers in daily life.**

**Packaging:** Polymers like polyethylene and polypropylene are used to make plastic bags, bottles, and containers.

**Clothing:** Synthetic fibers like nylon and polyester are used to produce durable and lightweight fabrics.

**9. What are composites?**

Composites are combined material formed by the assembly of two or more components, such as reinforcing agents and a compatible matrix binder in order to obtain specific characteristic properties. Two or more distinct components which combine to form a new class of material suitable for structural application are referred as composite materials. The components of a composite do not dissolve or merge completely into each other but act together, while retaining their individual identities.