**CHAPTER NO- 01**

**Chemical Energetics**

**1.1 Introduction:**

Energy is one of the most fundamental and universal concepts of physical science.Energy is basically twotypes kinetic and potential. Kinetic energy is associated with the motion of an object as a body with a mass (m)and moving at a velocity (v). Potential energy is energy by virtue of its location in a force field. The most common kinds of force fields are gravitational, electrical, or magnetic. Chemical thermodynamicsis the study of the inter relation of[heat](https://en.wikipedia.org/wiki/Heat)and[work](https://en.wikipedia.org/wiki/Thermodynamic_work)with[chemical reactions](https://en.wikipedia.org/wiki/Chemical_reaction)or with physical changes of[state](https://en.wikipedia.org/wiki/Thermodynamic_state)within the confines of thelaws of thermodynamics. Chemical energyis the potential of achemical substanceto undergo a transformation through achemical reactionor to transform other chemical substances. Breaking or making of chemical bonds involves[energy](https://en.wikipedia.org/wiki/Energy)or heat, which may be either absorbed or evolved from a chemical system. Energy that can be released (or can be absorbed) because of a reaction between a set of chemical substances is equal to the difference between the energy content of the products and the reactants.

**1.2 Basic thermodynamics:**

**1.2.1 Systems and surroundings:**

A[thermodynamic](https://en.wikipedia.org/wiki/Thermodynamic)systemis a body of matter and orradiation, confined in space by walls, with defined permeabilities, which separate it from its surroundings. A thermodynamic system can be described by state variables, which covers bothintensive and extensive properties. An**isolated**thermodynamic system has walls that are non-conductive of heat and perfectly reflective of all radiation, that are rigid and immovable, and that are impermeable to all forms of matter and all forces.A**closed**thermodynamic system is confined by walls that are impermeable to matter, but, alternately can be made permeable to heat, and for thermodynamic processes. An**open**thermodynamic system has at least one wall that separates it from another thermodynamic system.The wall being permeable to at least one chemical substance, as well as to radiation.

**Surroundings**

Everything external to the system is surroundings. The system is distinguished from its surroundings by a specified boundary which may be at rest or in motion. The interactions between a system and its surroundings, which take place across the boundary, play an important role in thermodynamics.

**1.2.2 Intensive and Extensive Properties**

There are certain properties which depend on the size or extent of the system, and there are certain properties which are independent of the size or extent of the system. The properties like volume, which depend on the size of the system are called extensive properties. The properties, like temperature and pressure which are independent of the mass of the system are called intensive properties.

**1.2.3 Phase in thermodynamics**:

Chemically and physically uniform or homogeneous quantity of matter that can be separated mechanically from a nonhomogeneous mixture and that may consist of a single substance or a mixture of substances.A phase is a quantity of matter characterized by both uniform physical structure and uniform chemical composition. A phase can be solid, liquid, vapor or gas. Solid phase are fixed relative to other atoms in the solid. They are however can vibrate about this fixed position.

**Homogeneous system**is defined as the one whose chemical composition and physical properties are the same in all parts of the system, or change continuously from one point to another. A homogeneous system can be exemplified by imagining a column of atmospheric air, which is a mixture of a number of gases, mainly nitrogen and oxygen. In a system of this kind, acted upon by the force of gravity, both the composition of the system and its physical properties will continuously change from one point to another.

**Heterogeneous system**is defined as one consisting of two or more homogeneous bodies. The homogeneous bodies of a heterogeneous system are referred to asphases.Each phase is separated from other phases by interfaces, or boundaries, and in passing over such a boundary the chemical composition of the substance or its physical properties abruptly change. This phase boundary must not be regarded as a mathematical surface but as a thin layer separating the phases, a layer where the properties of one phase pass, or turn, rapidly into the properties of the other phase.

An example of a heterogeneous system is water with ice floating in it. This system has two homogeneous bodies, water and ice. The chemical composition of the two phases is the same, but their physical properties differ drastically.

Another example of a heterogeneous system is the content of a sealed steel tube containing liquid mercury, liquid ethyl alcohol, and a mixture of saturated vapors of the alcohol and mercury. This heterogeneous system comprises three phases. The first phase is the liquid mercury, the second is the liquid ethyl alcohol, and the third phase is represented by the mixture of saturated vapors. Here the chemical compositions and the physical properties of all phases are different.