UNIT III - LAW OF THERMODYNAMICS

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3.1-INTRODUCTION TO THERMODYNAMICS

Thermodynamics is branch of physics which deals with temperature, heat and their relation to energy, radiation, work, and properties of matter. Thermodynamics means heat in motion. The key concept is that heat is a form of energy corresponding to a definite amount of mechanical work.

The study of thermodynamics is comprised of important laws of thermodynamics namely first law of thermodynamics, second law of thermodynamics, third law of thermodynamics and Zeroth law of thermodynamics.

The application of thermodynamic laws are found in all field of energy transfer, mainly in steam and nuclear power plants, internal combustion engine, gas turbine, air conditioning and refrigeration, air compressor and chemical process plants etc.

3.2-THERMODYNAMIC STATE

The condition of a system at any instant of time described by its physical properties is known as state of system. An operation in which properties of system change is called a change of state.

3.3-THERMODYNAMIC SYSTEM

A quantity of the matter or part of the space which is under thermodynamic study is called as system. It is shows in fig.1.1

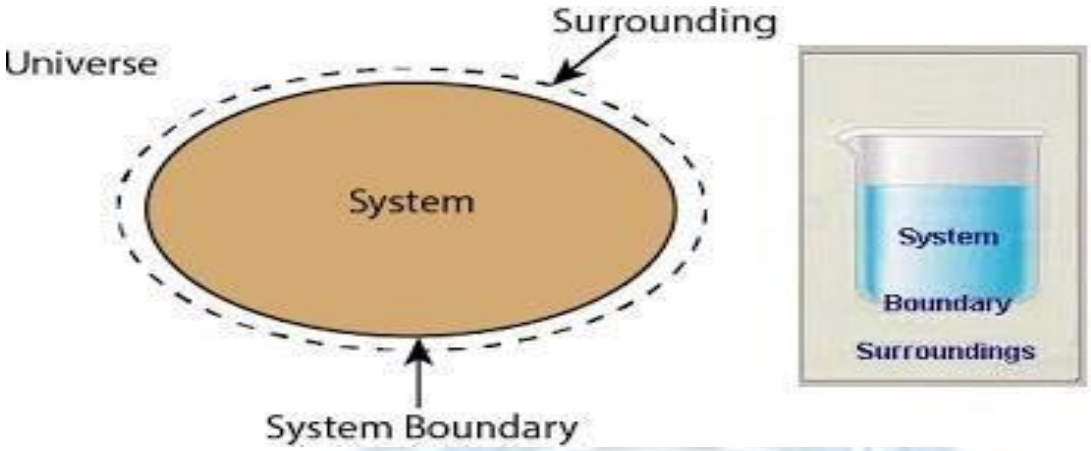

Fig. 1.1: Thermodynamic system

BOUNDARY

System and surroundings are separated by a definite border called boundary. It can be fixed or movable. System, surroundings and boundary constitute the universe.

SURROUNDING

Everything external to a thermodynamic system is called surroundings.

UNIVERSE

The system and the surroundings together make up the universe.

TYPES OF THERMODYNAMIC SYSTEMS

Thermodynamic systems can be broadly classified into three types. They are:

1. Open System
2. Closed system

3. Isolated system

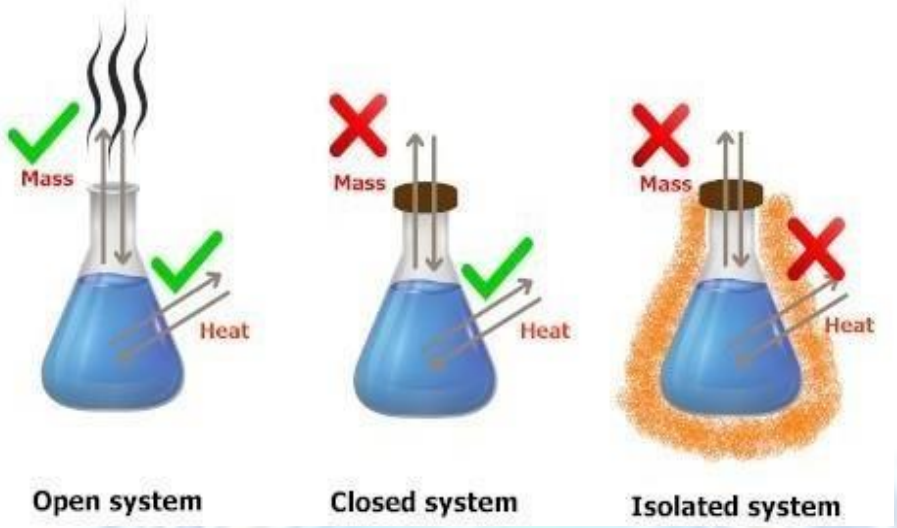

Fig. 1.2: Types of thermodynamic system

1. Open system

An open system is a thermodynamic system which allows both mass and energy to flow in and out of it, across its boundary.

2. Closed system

A closed system allows only energy (heat and work) to pass in and out of it. It does not allow mass transfer across its boundary.

3. Isolated system

It does not allow both mass and energy transfer across its boundary. It is more restrictive. In reality, complete isolated systems do not exist. However, some systems behave like an isolated system for a finite period of time.

However, there are some other terms by which the system or characteristics of a system are described. There are as below:

4. Adiabatic

The process during which work is done and no heat is transferred across the

system boundary is known as adiabatic process.

5. Homogeneous

The system that has single or uniform phase such as like solid or liquid or gaseous is called as homogeneous system.

6. Heterogeneous

The system that has more than one phase i.e. the combination of solid, liquid and gaseous state is called as heterogeneous system.

7. Macroscopic

In this approach a certain quantity of matter is considered without taking into account the events occurring at molecular level.

For example consider a sample of a gas in a closed container. The pressure of the gas is the average value of the pressure exerted by millions of individual molecules.

8. Microscopic

In microscopic study, the behavior of individual atoms and molecules of a substance considered. This approach considers that the systems are made up of a very large numbers of discrete particles known as molecules. These molecules have different velocities and energies. The values of these energies are constantly changing with time.

PROPERTIES OF THE SYSTEM

The characteristics by which the physical condition of the system is described are called as properties of system.

Some examples of these characteristics are: temperature, pressure, volume etc. are called as properties of system.

The system properties are of two types: extensive and intensive properties.

1. Extensive properties of system

The properties of the system that depend on the mass or quantity of the system are

called extensive properties. Some examples of extensive properties are: mass, volume, enthalpy, internal energy, entropy etc.

2. Intensive properties of the system

These properties do not depend on the quantity of matter of the system. Some of the examples of intensive properties are: freezing point temperature, boiling point, temperature of the system, density, specific volume etc.