

# Thermodynamics

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## Basic Concepts

### (i) Thermodynamics

It is the science of energy transfer and its effects on properties.

The main aim of thermodynamic study is to convert disorganised form of energy into organised form of energy in an efficient manner.

**System:**

It is a region in space on which the study is focused or concentrated.

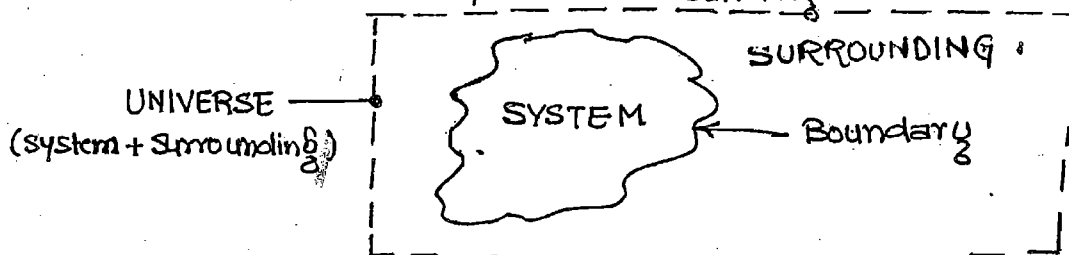
**Surroundings:**

Anything external to the system is known as surroundings.

**Boundary:**

The separation b/w system and surroundings is known as boundary.

- Universe is equal to system + surroundings



### NOTE:

Boundary can be rigid or flexible and real or imaginary.

### TYPES OF SYSTEM:

Types of system	Mass transfer	Energy transfer	Examples
(i) Closed system	X	✓	Piston cylinder w/o valves, gas in a sealed container
(ii) Open system	✓	✓	Turbines compressor pump boiler
(iii) Isolated system	X	X	Hot coffee in a well insulated flask, universe

### Microscopic and Macroscopic approach of thermodynamics

In microscopic approach the behaviour of individual molecules is taken into consideration. This approach is also known as Statistical thermodynamics.

This approach is generally used at low densities (higher altitudes).

In macroscopic approach the behaviour of individual molecules is not taken into consideration but the average behaviour of molecules is taken into consideration. This approach is also known as classical thermodynamics.

thermodynamics

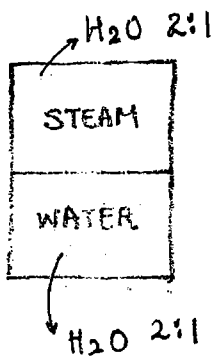
## Thermodynamic Equilibrium :

A system is said to be in thermodynamic equilibrium if it is in

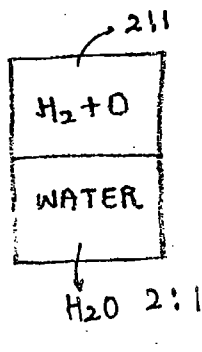
- (i) Thermal equilibrium (Equality of temperature)
- (ii) Mechanical equilibrium (Equality of forces/pressure)
- (iii) Chemical equilibrium (Equality of chemical potentials)

### Pure Substance :

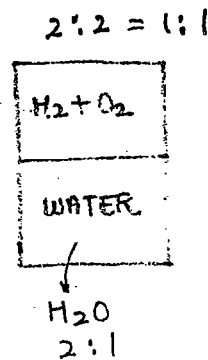
A substance is said to be a pure substance if it is homogeneous in chemical composition and homogeneous in chemical aggregation (bonding)



Pure substance



Not a pure substance



Not a pure substance

### Conditions

- |                                  |                   |                   |
|----------------------------------|-------------------|-------------------|
| (i) Homogeneous in chem. comp. ✓ | ✓ (satisfied)     | ✗ (Not satisfied) |
| (ii) chemical aggregation ✓      | ✗ (Not satisfied) | ✗ (Not satisfied) |

### PROPERTY OF A SYSTEM

All measurable characteristics are known as properties.

Properties are of two type

- (i) Intensive properties
- (ii) Extensive properties

- Intensive properties are independent of mass or size of ~~the~~ or size of the system.  
Eg: Pressure, Temperature, density, thermal conductivity, viscosity etc.
- Extensive properties depend upon size or mass of the system.  
Eg: volume, all forms of energy etc.

