Thermodynamics: It is the branch of Science which deals with energy and energy interection, its effect on System and Surroundings.

Energy: It is the ability to Cause changes. Energy is a general term embracing energy in transition and Stored energy.

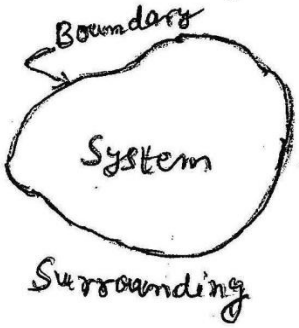
Examples of Stored energy are chemical energy, potential or gravitational energy due to height above a chosen datum line, Electrical energy etc.

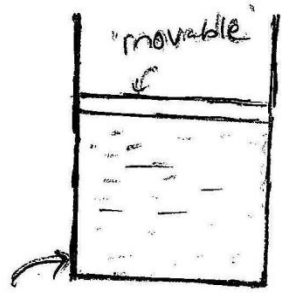
Examples of Transition energy are Heat and work. These are the only forms in which energy can cross the boundaries of a System. Neither heat nor work can exist as stored energy.

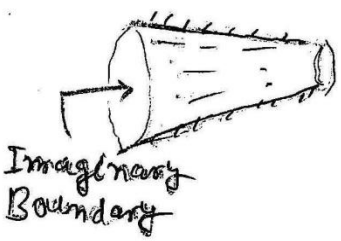
System: It is a fixed mass or a fixed region in space (Control volume) where our study is focused.

Surroundings: Everything except the System is Surrounding. "the part of Surrounding which is affected by the System is called immediate Surroundings.

Boundary: It is a real or imaginary Surface that separate the System from its Surroundings. Boundary can be fixed or movable.







Type of System: There are three classes of systems.

(i) Closed System: There is no mass transfer across the system boundary. There may be energy transfer into or out of the system. Examples, piston cylinder without valves.

(ii) Open System: Both matter or mass as well as energy crosses the boundary of the system. Examples, piston cylinder arrangment with valve, Compressor, Nozzle etc.

(iii) Isolated System: It is of fixed mass and energy, and there is no mass or energy transfer across the system boundary. Examples, Universe, Hot

The Concept of Macroscopic and Microscopic Approaches:

Macroscopic Approach: In this approach, we consider the average molecular behaviour and individual behaviour of molecules is disregarded. this approach is meanigful till the Continuum Concept is valid.

Continuum Concept: In this concept we consider the matter as Continuously distributed. this approach is meaningful till the mean-free-path (MFP) is much much less than the system dimensions. 'MFP' is the average distance travelled by a molecule between two Successive Collision.

Microscopic Approach: In this approach the individual molecular behaviour is taken into consideration and the average property like pressure, density etc losses their meaning. micro-scopic approach is used in Space exploration.

Thermodynamic property:

The State of the System is the condition of the System and it is specified by its properties. properties are the characteristics of the System. TDS properties can be classified as

(i) Intensive property (Intrinsic)

(ii) Extensive property (Extrinsic)

TDS properties:

(i) Intensive property (Intrinsic): These are independent of mass of the system under consideration.

Examples are pressure, temperature, density, thermal conductivity, Kinematic viscosity, Coeff of thermal expension (α) etc.

* All Specific properties are intensive property.

(ii) Extensive property: (Extrinsic): It depends on the mass of the System under consideration.

Examples, mass, volume, energy, entropy etc.

Note: (a) properties are point functions or state functions
(b) properties are exact differential

Thermodynamic Equilibrium:

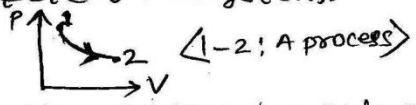
A System is said to be in thermodynamic equilibrium if it satisfies the following equilibrium

(i) Thermal equilibrium: Equality of temperature
(ii) Mechanical Equilibrium: Equality of forces i.e pressure at any point should not change with time
(iii) Chemical Equilibrium: The chemical composition should not change with time.

State of the System and process:

The Condition of the System is called State of the System.

Change of the state is called process.

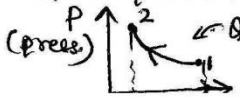


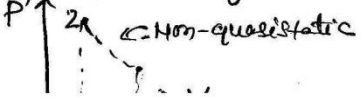
<1-2: A process>

The infinite state through which the system passes are going from initial state to a final state is called process path.

The process can be classified as;

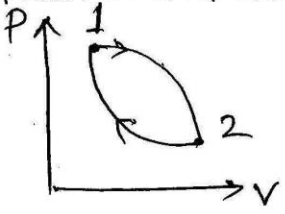
(1.) Quasi-static process: A process is said to be quasi-static if it is carried out in very-very slow manner otherwise the process is called non-quasistatic. A quasi-static process is generally represented by joined line on the property diagram & non-quasi-static process is represented by a dashed line.



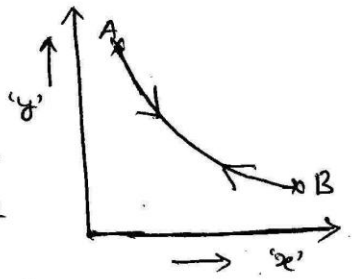


Reversible and Irreversible processes:

[Thermodynamic cycle: It is defined as a series of states changes such that the final state is identical with the initial state.



A process is said to be a reversible process if it can be reversed in the direction following the same path as of the forward process without leaving any change in the System and Surroundings. The process which is not reversible, called irreversible process.



let the state of a system be represented by 'A', and let the System be taken to state 'B' by following the path 'A-B'. If the System and also the Surroundings are restored or reversed in the direction to their initial states and no change in the System and Surrounding (i.e Universe) produce, then the process 'A-B' will be a reversible process.

[System + Surrounding = Universe]

A reversible process is carried out infinitely slowly with an infinitesimal gradient so that every state passed through by the System is an equilibrium state. So a reversible process coincides with a quasi-static process.

Any natural process carried out with a finite gradient is an irreversible process. All spontaneous process are irreversible.

Example of Reversible process; quasi-static Compression or expansion of a gas, Ideal flow etc.