Ch-1 Introduction

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*→ Thermodynamics is a science which deals with energy transfer & its effect on the system.

→ Zeroth law relates to the concept of equality of temperature & thermal equilibrium.

→ First law relates to the concept of law of conservation of energy.

→ Second law relates to the concept of the direction of flow of heat & limit of conversion of heat into work. Concept of Entropy.

→ Third law define the absolute zero to entropy.

*→ Prime mover:

Prime mover is a device which uses the energy from natural sources & convert it into mechanical energy.

*→ Source of Energy:

(1) Conventional or Non-renewable Sources of energy [Naturally occur]

(2) Non-conventional or Renewable Sources of energy [Wind, Geothermal Tidal, Solar, Wave Biogas, ocean thermal energy]

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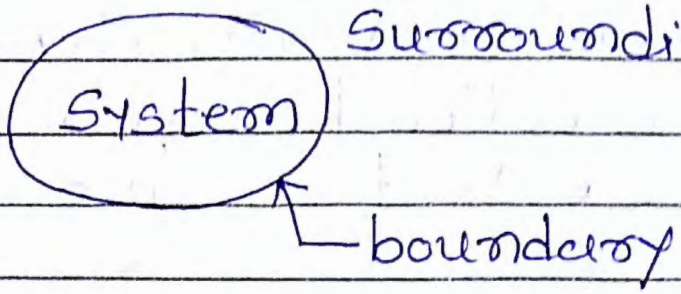
* Thermodynamic system:

It is a fix mass in region of space under consideration to analyse a Problem.

Surrounding:

Everything external to the system is called Surrounding.



Universe:

A system and its surrounding together is called the Universe.

* classification of system:

(1) Open System:

A system with mass transfer along with energy transfer across its boundaries is called open system.

Examples: Gas turbine

(2) Close System:

A system only energy transfer occur across the boundary.

Examples: Piston-cylinder

③ Isolated System:
There is no heat (energy) & mass transfer between the system & Surrounding is called isolated system.
Examples: thermoflask, Universe.

*→ Homogeneous & Heterogeneous System
→ If a system consist of homogeneous matter throughout in chemical composition and Physical structure it is called homogeneous system.
→ Ice, Water, Superheated system

→ If a system consisting of matter of different chemical compositions and Physical structure is called heterogenous system.
→ mixtures of ice & water, Wet steam

*→ Force: A Force of 1 N is defined as the force required to accelerate a mass of 1 kg by 1 m/s². $F = m.a$ $1N = 1 kg m/s^2$

→ Weight: The weight of a body is the Force with which a body is attracted to the centre of earth. $W = m.g$

→ Energy: Energy can be defined as the capacity to do work.

Forms of Energy:

① Internal Energy
- → Chemical Energy
- → Atomic Energy
- → Molecular internal Energy

② External Energy
- → Potential Energy $P.E. = m.g.z$
- → Kinetic Energy $K.E. = \frac{1}{2} m.c^2$

* → Properties:

(1) Intensive Property: The Properties which are independent of the mass of the system are called intensive Property.

Ex. Pressure, temperature, viscosity.

(2) Extensive Property: The Properties of the system which depends upon the size and mass of the system. is called Extensive Property.

Ex Length, Volume, all forms of energies & Entropy.

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*→ Thermodynamic Equilibrium:
A system is said to be in thermodynamic equilibrium which is incapable of any spontaneous change of its macroscopic properties and it is in complete balance with its surroundings.

(1) Mechanical Equilibrium:
A system is said to be in mechanical equilibrium if there are no unbalanced forces in the interior of the system with its surroundings.

(2) Thermal Equilibrium:
The thermal equilibrium denotes the uniformity of temperature inside with its surroundings.

(3) Chemical Equilibrium:
The chemical Equilibrium represent the absence of any chemical reaction or phase change of any system.

*→ Quasistatic Process: Process in which the properties of the system depart infinitesimally (extremely small) from the thermodynamic equilibrium path.

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* Non-Quasistatic Process: If the properties of the system has finite departures from thermodynamic equilibrium path the process is said to be non-quasistatic process.

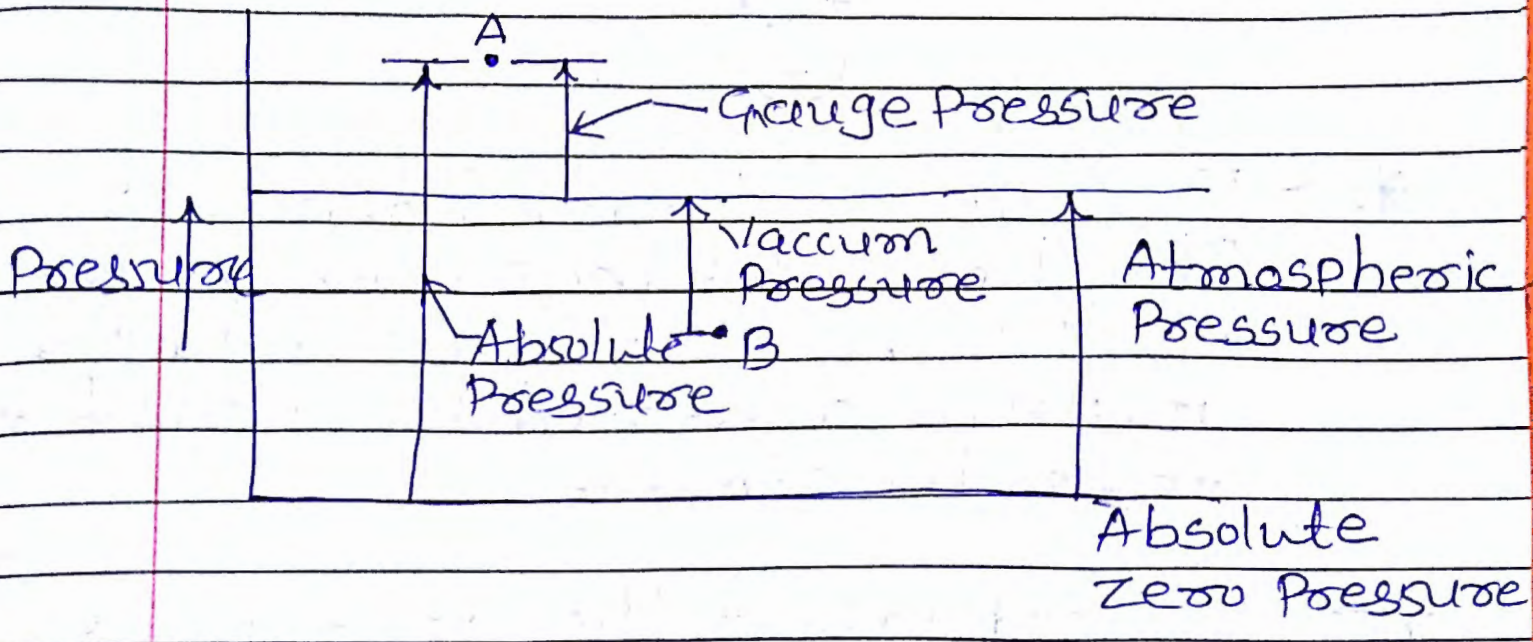
* Pressure:
Pressure is the property of fluid and it is defined as force per unit area.

$$P = \frac{\text{Force}}{\text{Area}} \quad N/m^2$$

1 kPa, 1 MPa $1\,Pa = 1\,N/m^2$

$1\ bar = 10^5\ Pa$ or N/m^2

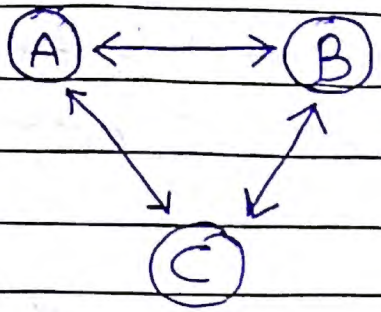
$P = \rho g h = 1.01325\ bar$



Absolute Pressure = Atmospheric Pre. + Gauge Pressure

*→ Temperature:
The temperature is a property of the system or thermal state of a body which distinguishes a hot body with a cold body.

*→ Zeroth law of thermodynamics:
If two bodies A & B are individually in thermal equilibrium with a third body C, then the two bodies A & B will also be in thermal equilibrium with each other.



*→ First law of thermodynamics:
This law states that energy can neither be created nor destroyed it can be converted from one form to another form.

*→ Second law of thermodynamics:
→ Clausius Statement: It is impossible to have a device that While operating

in a cycle produces no effect other than transfer of heat from a body at lower temperature to a body at higher temperature.

→ Kelvin-Plank Statement: It is impossible for a device operating in a cycle to produce network while exchanging heat with bodies at single fixed temperature.

*→ Heat: heat is the form of energy which is transfered without transfer of mass, from one body to another body, From higher temperature to lower temperature by virtue of temperature difference between two bodies.

*→ Power: It is the time rate of doing work. Watt (J/s or Nm/s)
1 KW = 1 W = 1000 J/s

*→ Difference between heat & Work
(1) Heat can only transferred when there is difference of temperature between the system & surrounding.

While the work transfer can take place even without change in temp between the system & Surroundings.

(2) In a constant volume Process through the displacement work cannot be take place, heat can be transferred.

(3) In case of work transfer, its sole effect could be raising or lowering a weight in the surrounding but in case of heat transfer other effects are also observed. grade energy

(4) Heat is low grade energy while work high

*→ Similarities between heat & Work

(1) Both heat & Work exist in transit & these are never Possessed or contained in a system.

(2) Both heat & Work refer to boundary Phenomena. both represent the transfer of energy across the boundary of the system.

(3) Both heat and Work are Path Functions and do not represent

the Property of the system. Both are in exact differentials.

* → Specific heat : Amount of heat required to raise the temperature of 1 kg of substance by 1 degree of temperature.

Cv : Amount of heat required to raise the temperature of unit mass of gas by one degree at constant Volm.

Cp : Amount of heat required to raise the temperature of unit mass of gas by one degree at constant Pressure.

* → Enthalpy : $H = U + P \cdot V$ Joule / KJ