16ME201 — ENGINEERING THERMODYNAMICS.

1. BASIC CONCEPT & FIRST LAW.

Definition :-

Thermodynamics is deals with the science of energy transfer and its effects on the physical properties of substances. It is based on the principle of energy conservation.

The application of the thermodynamics & principles are found in all fields of energy technology like steam nuclear power plant, I.C. engine, gas turbine, air conditioning, refrigeration, jet propulsion etc.

Thermodynamics [Greek word]

Therme + Dynamics .
↓ ↓
Heat Power .

The conversion of heat into power (or) work is called as thermodynamics [Mechanical work].

Law of Conservation of Energy.

It states that energy can change from one form to another form without losses during the energy interaction.

Density (ρ) :-

$$\text{Density } \rho = \frac{mass}{Volume} = \frac{m}{V} = kg/m^3 \text{ . (SI unit)}$$

Specific Weight (W) :-

$$\text{specific Weight (W)} = \frac{weight}{Volume} = \frac{W}{V} = N/m^3 \text{ (S.I unit)}$$

Specific Volume (v) :-

$$\text{Specific Volume (v)} = \frac{volume}{mass} = \frac{v}{m} \quad m^3/kg .$$

$$\left(\text{inversely proportional to density } (\rho)\right) \quad v \propto \frac{1}{Density} = 1/\rho$$

Specific Gravity (S) :-

$$\text{Specific Gravity (S)} = \frac{Density \ (or) \ sp. \ weight \ of \ the \ given \ substance}{Density \ (or) \ sp. \ weight \ of \ the \ std. \ substance}$$

Std. substances → Liquid is water
Air is gas } No units .

Pressure (P) :-

$$\text{Pressure (P)} = \frac{\text{Force}}{\text{Area}} = F/A = N/m^2 \quad (\text{SI unit})$$

$$1 \text{ pascal} = 1 \text{ } N/m^2$$

$$1 \text{ bar} = 10^5 \text{ } N/m^2$$

Atmospheric Pressure :-

The pressure exerted by the air on the atmosphere.

It's value is 1.013 bar.

Gauge Pressure (P_a) :-

The pressure is recorded by the gauge pressure. At atmospheric pressure level, all the pressure will be "zero" atm. pressure.

Vaccum Pressure (P_{vac})

The pressure below the atmospheric pressure and also called as negative pressure,

It is used to measure vaccum pressure is called vaccum gauge.

Gauge pressure
Absolute pressure
Atmospheric pressure.
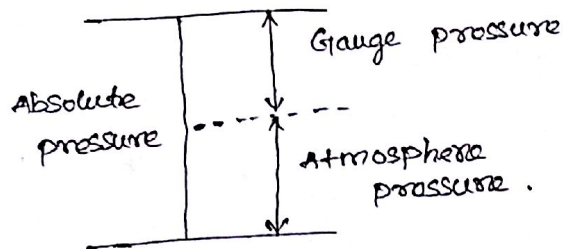
Absolute Pressure [P_{Abs}] :-

Pressure measured from absolute zero pressure.

$$\text{Absolute pressure} = \text{Atm. pr} + \text{Gauge. Pr}.$$

$$= \text{Atm. Pr} - \text{Vacuum Pr}.$$

Temperature :-

Measuring of velocity of fluid particles.

Absolute Temperature :-

The temperature measured from the absolute zero temperature is called as absolute temperature.

celsius → kelvin.

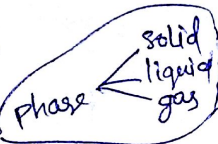$$T = t + 273 \text{ K}$$

eg: $T = 30°C$

$$T = 30 + 273 \text{ K} = 303 \text{ K}.$$

Concept of Continuum :-

A continuum homogenous molecules is called as continuum. It is based on the macroscopic approach.

Homogenous — A system consisting of single phase.

Phase → solid, liquid, gas

Heterogenous — A system consisting of more than one phase.

We are always concerned with volumes which are very large compared to molecules dimensions. Even a very small volume system is assumed to contain a large number of molecule. So that statistical averaging is meaningful. Disregarding the behaviour of individual molecules. The matter is treated as a continuous here.