B. Sc (H) - III     Paper - VI, Gp A     06-02-24
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# STATISTICAL MECHANICS

* We know that, thermodynamics is the macroscopic theory of matter → concepts are ~~based~~ taken directly from experiments.

* Statistical Mechanics → Microscopic theory of a system

$$N \to O(10^{23})$$

~~Hamiltonian~~ ~~$H = \sum_{i=1}^{N} \frac{\vec{p}_i^{\,2}}{2m} + \sum_{\alpha,\beta} V_1 \; V_0 \; + V_1 \sum$~~

Hamiltonian

$$H = \sum_{i=1}^{N} \frac{\vec{p}_i^{\,2}}{2m} + V_0 + \sum_{\alpha,\beta} V_1(\vec{r}_\alpha, \vec{r}_\beta) + \sum_{\alpha,\beta,\gamma} V_2(\vec{r}_\alpha, \vec{r}_\beta, \vec{r}_\gamma) + \cdots$$

→ Thermodynamics is described in terms of $T, V, N, S, G$ ---

→ Statistical mechanics description are obtained starting from microscopic parameters $\{\vec{r}_i, \vec{p}_i\}_{i=1}^{N}$

Before going onto detail of Statistical Mechanics Course, here I review thermodynamics in short —

(i) Thermodynamic system → A macroscopic system such as a fluid system,

(ii) State variables / Thermodynamic parameters :—

Pressure, volume, Temperature, entropy, Gibbs free energy, specific heat etc. (of a gas.)

$P, V, T, S, G, C_P, C_V$ ---

(iii) Equation of state :—

A functional relation between thermodynamic parameters —

$$f(T, V, N, P \ldots) = 0$$

For example, Ideal gas case → $PV = RT$

(iv) Extensive quantity → Depend on system size

$E, V, N$ --

(v) Intensive quantity → Independent on system size –

$T, P, \mu$ ..

vi Laws of thermodynamics :—

(a) Zeroth law

(b) First law

(c) Second law

(d) Third law

(a) Zeroth law :— If system A is in equilibrium with system B and C then B is in equilibrium with C

If $T =$ const. → Thermal equ.

$\mu =$ const. → chemical equ.

$P =$ const. → Mechanical equ