prof. Vidya Sagar
Department of physics
Raja Singh college, Siwan

B.Sc (Part-I) Hons
Paper-II

First Law and Second law of Thermodynamics.

First Law of Thermodynamics :- The first law of thermodynamics is usually referred to the Conservation of energy and goes on to state that heat added to a system equals the increase in internal energy plus work done by the system.

When-ever other forms of energy are Converted into heat or vice-versa ~~there~~ there is a fixed ratio between the quantities of energy and heat thus Converted.

The differential form of the first law of thermodynamics is given by

$$\partial Q = \partial U + \partial W \quad \text{---- (1)}$$

Where ∂Q = Heat energy absorbed by the System
∂U = Increase in internal energy of the System.
$\partial W = P\partial V$ = work done by the System

Equation (1) is called the mathematical formation of the first law of thermodynamics. Thus the first law is not Simply the law of Conservation of energy. It Contains three related ideas.

(i) The existance of an inertial energy function
(ii) The principle of Conservation of energy.
(iii) The definition of heat as energy in transit due to temperature difference.

Let two systems separated by a diathermic wall and the whole system is insulated. Applying the first law.

$$Q_1 = W_1 + \Delta U_1 \quad \text{(for system 1)}$$

and $$Q_2 = W_2 + \Delta U_2 \quad \text{(for system 2)}$$

Adding, we get

$$Q_1 + Q_2 = (W_1 + W_2) + (\Delta U_1 + \Delta U_2)$$

$(W_1 + W_2)$ is the total work done by the system. $(\Delta U_1 + \Delta U_2)$ is the change in the internal energy of the system. Hence $(Q_1 + Q_2)$ is the total heat added in to the system, since it is insulated

$$\therefore Q_1 + Q_2 = 0$$

$$\text{or, } Q_1 = -Q_2$$

In other words, heat lost by a system is equal to heat gained.

Second Law of Thermodynamics:—

Kelvin's ~~planck~~ statement:— It is impossible to get a continuous supply of work from a body by cooling it to a temperature lower than that of its surroundings.

Clausius statement:— It is impossible to make heat flow from a body at a lower temperature to a higher temprature without doing external work on the working substance.

This is applicable in case of ice plants and Refrigerators.