{ B.Sc Part I Physics (Hons)
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Ques:- what is thermodynamics. State the first law of thermodynamics and discuss its physical significance & limitation.?

Ans:- **Thermodynamics:-**

It is the science that discuss the relation of heat to mechanical work. It establishes the equivalence between the work done and the heat produced. The principle of thermodynamics are very general and give the relation of heat to other forms of energy e.g. electrical, light etc

Mechanical Equivalent of heat:-

Whenever work is transformed into heat and heat into work, the quantity of work is mechanically equivalent to the quantity of heat.

$$W \propto H$$
$$W = JH$$

where J = Constant known as Joule's mechanical equivalent of heat. The value of J is 4.186 Joules/calorie & 4.186×10^7 ergs per calorie. In S.I system both W and H are measured in Joules. Therefore, in this system J = 1 and therefore W = H

First law of thermodynamics:-

Whenever heat is imparted to a body, a part of it is used to increase its internal energy, i.e to raise its temperature and the resting doing external work. If dQ is the heat energy absorbed by a system, du the increase in its internal energy and dw the external work done by it, then provided all the quantities are measured in units of work.

$$\therefore dQ = du + dw$$

This is known as the first law of thermodynamics.

Differential form of First law of thermodynamics:-

$$\therefore dQ = du + dw$$

This is the differential form of the first law of thermodynamics. If the pressure remain constant at P and change in volume dV taked place, then

$$dw = P \cdot dV$$
$$\therefore dQ = du + P\,dV$$

the grating for light of wave-

Physical significance and limitation of first law:-

The first law of thermodynamics is simply the conservation of energy principle in its most general form. It recognizes transfer of energy through either work or heat and it includes in the internal energy of the system all forms of energy due to ordered as well as disordered motion of the particles of the system. Work is the macroscopic displacement of a body and represents ordered K.E and P.E. Heat on the other hand measures energy of disordered motion of the articles of the system arising form of temperature difference. This law can be stated as

In all transformation, the energy due to heat supplied to the system must be balanced by the external work done plus the increase in internal energy.

This law establishes the relation between heat and work. According to this law heat can be produced only by the expenditure of energy in some form or the other. Hence it follows directly from this law that it is impossible to make a perpetual motion machine or to derive work without any expenditure of energy.

It does not, however, specify the condition under which a body can use its heat energy to produce a supply of work nor does it say that how much of the heat energy of the body can be converted into useful work.