Thermodynamics-II

Need of the Law

The major loopholes in First law in summary:

- First law fails to provide any restriction on the direction of flow of heat.
- It doesn’t give any idea about the spontaneity or feasibility of the process.
- While the First law emphasizes on the conversion of energy from one form to the other completely in form of work, part of energy loss is left unnoticed.

Second law of Thermodynamics

To overcome the above loopholes of First law, Second law of thermodynamics was introduced. Second law helps us to understand the direction of energy transfer as well as understand the spontaneity of any process. Second law introduces us to a new term ‘entropy’ which we will study in details further.

Different Statements of the Law

i. All spontaneous processes like the flow of heat from hot to cold end, flow of water down the hill, diffusion of gases from higher to the lower pressure region etc. are completely irreversible in thermodynamic frames. Spontaneity means a process that can occur without the need of an external driving factor. All natural processes are spontaneous in nature.

ii. As First law stated that when heat is converted in the form of work, work done is equivalent to the energy absorbed which is not true completely. Second law states that Heat cannot be converted to work completely without leaving impacts on system or surroundings.

iii. According to the Kelvin, Second law can be stated as “it is not possible to use a cyclic process for extracting heat from a source and convert it into equivalent amount of work without losing some amount of heat from hotter to the colder part of the system.

Cyclic Process

System that tends to return to its original state after going through a series of changes completes a cycle. This cycle of processes that brings system back to its initial states after different changes is known as cyclic process. As we know that the internal energy of a system is completely a state function, therefore, $\Delta U=0$ and considering the First law, $\Delta U=q+w=0$

We can say, q=-w.

When the temperature of the system remains constant throughout the cycle, it is termed as isothermal cyclic process and when the changes are reversible the cycle is also called reversible cycle (an imaginary concept). Although, reversibility of cycle is a completely imaginary concept, Carnot explained this reversible cycle in terms of maximum conversion of heat into work. This is known as Carnot cycles.