❖ 1st lAW OF THERMODYNAMICS:

- INTRODUCTION:-

Thermodynamics is the study of the energy, principally heat energy, that accompanies chemical or physical changes. The first law of thermodynamics is a formulation of the law of conservation of energy, adapted for thermodynamic processes. It distinguishes in principle two forms of energy transfer, heat and thermodynamic work for a system of a constant amount of matter. The law also defines the internal energy of a system, an extensive property for taking account of the balance of energies in the system.

- DERIVATION:-

- In any process, energy can never be created or destroyed; it can only be transferred. From one object to another in the form of heat and/or work. This statement is called the First Law of Thermodynamics, and it can also be written as a mathematical equation:

$\Delta U = Q + W$

- ANALYSIS:-

- The laws of thermodynamics are deceptively simple to state, but they are far-reaching in their consequences. The first law asserts that if heat is recognized as a form of energy, then the total energy of a system plus its surroundings is conserved; in other words, the total energy of the universe remains constant. The first law is put into action by considering the flow of energy across the boundary separating a system from its surroundings. Consider the classic example of a gas enclosed in a cylinder with a movable piston. The walls of the cylinder act as the boundary separating the gas inside from the world outside, and the movable piston provides a mechanism for the gas to do work by expanding against the force holding the piston (assumed frictionless) in place. If the gas does work W as it expands, and/or absorbs heat Q from its surroundings through the walls of the cylinder, then this corresponds to a net flow of energy W – Q across the boundary to the surroundings. In order to conserve the total energy U, there must be a counterbalancing change ΔU = Q – W (1)in the internal energy of the gas. The first law provides a kind of strict energy accounting system in which the change in the energy account (ΔU) .There is an important distinction between the quantity ΔU and the related energy quantities Q and W. Since the internal energy U is characterized entirely by the quantities (or parameters) that uniquely determine the state of the system at equilibrium, it is said to be a state function such that any change in energy is determined entirely by the initial (i) and final (f) states of the system: ΔU = Uf – Ui. However, Q and W are not

- SIGNIFICANCE :-

The first law of thermodynamics has the following significances:

▪ It establishes the relation between heat and work. The total energy of an isolated system must remain constant.

▪ According to this law, a fixed amount of heat is needed to get a fixed amount of work or to get a fixed amount of heat a fixed amount of work is needed.

▪ It is impossible to get work or energy without expending something.

▪ Work and heat are equivalent to each other.

▪ It is nothing but the principle of conservation of energy. In any system, the sum of work done and change in internal energy is always equal to supplied heat.

▪ If the system gained or loss energy then exactly the equivalent amount of energy of surrounding will have a loss or gain.

▪ No engine has been built which is able to perform work without expending fuel or energy, i.e., it is not possible to invent the perpetual motion machine which can perform work without expending energy.

▪ You cannot have a device which gives output as work without any heat input. This device is known as a perpetual motion machine of the 1^{st} kind which is not probable.

▪ The first significance is related to the law of conservation of energy, Heat, and work both are different forms of the same entity known as Energy which is conserved.

▪ Whenever a definite quantity of one kind of energy disappears, an accurately correspondent amount of some other kind must appear.

▪ The energy of an isolated system is constant. Example: Universe

- CONCLUSION:-

The energy of the universe remains constant, according to the first law of thermodynamics. It can be exchanged between the system and the environment, but it cannot be generated or destroyed. The law is primarily concerned with changes in energy states caused by work and heat transmission.