9$^{\text{Th}}$ Class

➢ **Law of Conservation of Energy**

❖ **Introduction:**

The Law of Conservation of Energy is a fundamental principle in physics that states that the total energy of an isolated system remains constant over time. In other words, energy cannot be created or destroyed, only transferred or converted from one form to another.

❖ **Forms of Energy:**

1. **Kinetic Energy (KE):** The energy associated with the motion of an object. It is given by the formula $KE = \frac{1}{2}mv^2$, where m is the mass and v is the velocity.
2. **Potential Energy (PE):** The energy associated with the position of an object in a force field. Examples include gravitational potential energy and elastic potential energy.
3. **Mechanical Energy (ME):** The sum of kinetic and potential energy in a system. $ME = KE + PE$.
4. **Heat Energy (Q):** The energy associated with the random motion of particles in a substance.
5. **Chemical Energy:** The energy stored in the bonds between atoms and molecules in a substance.

❖ **Law of Conservation of Energy:** The law states that the total mechanical energy (the sum of kinetic and potential energy) in an isolated system remains constant as long as only conservative forces (forces like gravity or spring force) are at play. Mathematically, it can be expressed as:

Initial ME + Work done = Final ME

$ME_{\text{initial}} + W = ME_{\text{final}}$

Where W is the work done on or by the system.

❖ **Examples of Conservation of Energy:**

1. **Pendulum Swing:** As a pendulum swings back and forth, the total mechanical energy remains constant, converting between potential and kinetic energy.
2. **Free-falling Object:** In the absence of air resistance, a free-falling object conserves its mechanical energy.

❖ **Non-conservative Forces:**

Non-conservative forces, such as friction or air resistance, can do work on a system and convert mechanical energy into other forms (usually heat). In the presence of these forces, the total mechanical energy of a system may not remain constant.

❖ **Conclusion:**

Understanding the Law of Conservation of Energy is crucial in analyzing and solving problems related to the transfer and transformation of energy in various physical systems. It provides a fundamental framework for understanding the behavior of energy in the universe.