CHAPTER 9

WORK, ENERGY AND POWER

NOTES

Work: When an object moves under an applied force in the direction of it, then the force has done work on the object.

The work done by a force acting on an object is equal to the product of the force and displacement of the object in the direction of the force.

- Work done is mathematically equal to the product of the magnitude of the applied force (F) and the displacement (s). That is

$$W = Fs, \tag{9.1}$$

- Work done has only magnitude but no direction.
- The SI unit of work done is Nm or Joule (J).
- Work done is positive when the force is in the direction of the displacement.
- Work done is negative when the force is opposite to the direction of displacement.

Energy: Any object having capability to do work is said to possess energy. The object which does work lose energy whereas the object on which the work is done gain energy.

- The energy possessed by an object is measured in terms of its capacity for doing work.
- The SI unit of energy is Joule (J).

1kJ= 1000 J

1MJ=106 J

- The various forms of energy are:
  - Mechanical energy (kinetic energy and potential energy)
  - Heat energy
  - Chemical energy
  - Electrical energy
  - Light energy
  - Sound energy

Kinetic energy: It is the energy possessed by an object due to its motion.

- The kinetic energy possessed by an object of mass *m* moving with a uniform velocity *v* at any instant of time is

$$E_k = \frac{1}{2} mv^2. \qquad (9.2)$$

Potential Energy: The energy possessed by an object due to its position or configuration is called potential energy.

- The potential energy of an object increases when it is raised from a lower level to a higher level because of the work done on it against the gravity while it is being raised.
- The potential energy of an object of mass *m* at a height *h* is

$$E_p = mgh. \qquad (9.3)$$

- Energy can be converted from one form to another.
- **Law of conservation of Energy:** It states that energy can never be created nor destroyed but can be transformed from one form to another. The total energy before and after the transformation remains the same.

Power: Power the rate of doing work or the rate of transfer of energy.

- **Mathematical form of power:** Power (*P*) is defined as the work done (*W*) or energy transferred per unit time (*t*). That is,

$$P = \frac{W}{t}. \qquad (9.4)$$

- The SI unit of power is **Watt** having the symbol W in honor of James Watt.

1 kilowatt= 1000 watt= 1000 Js^{-1}

1 megawatt= 10^6 watt= 106 Js^{-1}

- **Commercial unit of energy:** The commercial unit of energy is kilowatt hour represented as kWh.

  1 kilowatt hour = 3.6×10^6 J

- The energy used by a machine or work done by a machine at the rate of kW in one hour is called **1kilowatt (kWh).**

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