WORK, ENERGY AND POWER

1. **Notions of work, work-energy theorem, power**
2. **Kinetic energy**
3. **Potential energy**
4. **The conservation of Energy**
5. **Non-conservative forces-Motion in a vertical circle, Collisions**

SUMMARY

1. The work-energy theorem states that the change in kinetic energy of a body is the workdone by the net force on the body.

$$\mathrm{K}_f - \mathrm{K}_i = \mathrm{W}_{net}$$

2. A force is conservative if (i) work done by it on an object is path independent anddepends only on the end points {xi, xj}, or (ii) the work done by the force is zero for anarbitrary closed path taken by the object such that it returns to its initial position.

3. For a conservative force in one dimension, we may define a potential energy function V(x)such that

$$\mathrm{F}\ (\mathrm{x}) = \frac{dV(x)}{dx}$$

$$\text{or } \mathrm{V}_1\ \mathrm{V}_j = \int_{x_i}^{x_f} F(x)dx$$

4. The principle of conservation of mechanical energy states that the total mechanicalenergy of a body remains constant if the only forces that act on the body are conservative.

5. The gravitational potential energy of a particle of mass m at a height x about the earth’s surface is V(x) = m g x

where the variation of g with height is ignored.

6. The elastic potential energy of a spring of force constant k and extension x is
$$V\,x = \frac{1}{2}\ k\,x^2$$

7. The scalar or dot product of two vectors A and B is written as A. B and is a scalarquantity given by : A.B = AB cos θ, where θ is the angle between A and B. It can bepositive, negative or zero depending upon the value of θ. The scalar product of twovectors can be interpreted as the product of magnitude of one vector and componentof the other vector along the first vector. For unit vectors :

$$\widehat{i}.\,\hat{i} = \hat{j}.\,\hat{j}$$
$$= \hat{k}.\hat{k} = 1 \text{ and } \widehat{i}.\,\hat{j}$$
$$= \hat{j}.\hat{k} = \hat{k}.\hat{i} = 0$$

Scalar products obey the commutative and the distributive laws.

Physical Quality	**Symbol**	**Dimensions**	**units**	**Remarks**
Work	W	$[ML^2T^{-2}]$	J	W=F.d.
Kinetic Energy	K	$[ML^2T^{-2}]$	J	$K = \frac{1}{2}m\nu^2$
Potential energy	V(x)	$[ML^2T^{-2}]$	J	$F(x) = \frac{dv(x)}{dx}$
Mechanical energy	E	$[ML^2T^{-2}]$	J	E= K+V
Spring Constant	K	T^{-2}	$[Nm^{-1}]$	$textF = -\mathrm{kx}$ $\mathrm{V}\,(\mathrm{x}) = \frac{}{2}kx^2$
Power	P	$[ML^2\quad{}^3]$	W	P=F.v P $=$ dw