11^{th} Physics Unit - 2

Kinematics

- **Mechanics** is divided into ***statics and dynamics***.
- ***Statics*** - study of **objects at rest.**
- ***Dynamics*** – study of **moving objects**.
- ***Dynamics*** is divided into
  - ✓ **Kinematics**
  - ✓ **Kinetics**
- **Kinematics -** The study of the relationship between displacement, velocity, acceleration and time of a given motion, without considering the forces that cause the motion.
- **Kinetics -** The relationship between the motion of bodies and forces acting on them.
- When a body **does not change its position** with **respect to time**, then it is said to be at ***rest.***
- ***Motion*** - The **change of position** of an object with respect to time.
- **Motion** is classified into **three** types
  - ✓ **Motion in One dimension**
  - ✓ **Motion in Two dimension**
  - ✓ **Motion in Three dimension**

- The motion along a **straight line** is known as ***rectilinear motion***.
- ***Speed-*** Distance travelled by time and it is a ***scalar quantity***.
- **Uniform velocity -** if it moves along a fixed direction and covers equal displacements in equal intervals of time.
- **Retardation or deceleration -** velocity decreases with time, the acceleration is negative.
- The ***scalar*** quantities have ***magnitude only***.
- The ***vector*** quantities have ***both magnitude and direction***.
- **Triangle law of vectors - ** If two vectors are represented in magnitude and direction by the two adjacent sides of a triangle taken in order, then their resultant is the closing side of the triangle taken in the reverse order.
- **Parallelogram law of vectors - ** If two vectors acting at a point are represented in magnitude and direction by the two adjacent sides of a parallelogram, then their resultant is represented in magnitude and direction by the diagonal passing through the common tail of the two vectors.
- **Angle of projection -** The angle between the initial direction of projection and the horizontal direction through the point of projection.
- **Velocity of projection -** The velocity with which the body is projected.
- **Range -** The horizontal distance between the point of projection and the point where the projectile hits the ground.

- **Trajectory -** The path described by the projectile.
- **Inertia -** The property of a body by virtue of which the body is unable to change its state by itself in the absence of external force.
- The inertia is of **three** types
  - ✓ Inertia of rest
  - ✓ Inertia of motion
  - ✓ Inertia of direction.
- The **momentum** of a body is defined as the product of its **mass and velocity**.
- **Momentum** has both **magnitude and direction.**
- **Newton's first law of motion-** It states that every body continues in its state of rest or of uniform motion along a straight line unless it is compelled by an external force to change that state.
- **Newton's second law of motion -** the rate of change of momentum of a body is directly proportional to the external force applied on it and the change in momentum takes place in the direction of the force.
- **Newton's third Law of motion –** For every action there is an equal and opposite reaction.
- **Impulsive Force –** An impulsive force is a very great force acting for a very short time on a body, so that the change in the position of the body during the time the force acts on it may be neglected.

- **Impulse of a force -** The impulse J of a constant force F acting for a time t is defined as the product of the force and time.
- **Parallelogram law of forces -** If two forces acting at a point are represented in magnitude and direction by the ***two adjacent sides of a parallelogram***, then their resultant is represented in magnitude and direction by the diagonal passing through the point.
- **Triangle law of forces -** If two forces acting at a point are represented in magnitude and direction by the ***two adjacent sides of a triangle*** taken in order, then the closing side of the triangle taken in the reversed order represents the resultant of the forces in magnitude and direction.
- **Lami's theorem -** if three forces acting at a point are in equilibrium, then each of the force is directly proportional to the sine of the angle between the remaining two forces.
- **Angular displacement -** The angle swept by the radius vector at a given time.
- **Angular velocity-** The ***rate of change of angular displacement***.
- **Centrifugal reaction -** The equal and opposite reaction to the centripetal force.
- **Energy** - Defined as the **capacity to do work.**
- **Potential energy** -The energy stored in the body by virtue of its position or the state of strain.
- **Kinetic energy** - The energy possessed by the body by virtue of its motion.

- **Work – Energy theorem -** The work done by a force acting on the body during its displacement is equal to the change in the kinetic energy of the body during that displacement.
- **Elastic collision -** The ***kinetic energy of the system is conserved*** during a collision.
- **Inelastic collision -** During a collision between two bodies if there is a ***loss of kinetic energy.***

IMPORTANT FORMULAS

Resultant $R^2 = P^2 + Q^2 - 2PQ \cos(180° - \theta)$

Resultant $R = \sqrt{P^2 + Q^2 + 2PQ \cos\theta}$

Impulse = Force × time $J = F \times t$

Law of conservation of momentum $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

Lami's theorem $\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$ = constant

potential energy $E_P = mgh$

Kinetic energy $E_k = \frac{1}{2} mv^2$

Work–energy theorem $= m\left[\frac{v^2}{2}\right]_{v_1}^{v_2} = \frac{mv_2^2}{2} - \frac{mv_1^2}{2}$