CHAPTER 7

FORCE AND LAWS OF MOTION

NOTES

- **Force** is the cause which produces the change in the state of rest or uniform motion of the body on which it acts.
- A force or a set of forces can
  - change the shape of the body,
  - change the direction of motion of the body, and
  - change the shape of deformable bodies.
- If forces acting on a body produce no acceleration in it, the forces are said to be balanced. If, on the other hand they produced a non-zero acceleration, the force is said to be unbalanced.
- The natural tendency of object resisting a change in their state of rest or uniform motion is called inertia. The mass of a body is a measure of its inertia and its SI unit is Kilogram (kg).
- **Newton's laws of motion:**

***First law of motion*:** It states that "everybody continues in its states of rest or of uniform motion in a straight line unless compelled to change that state by an external applied force."

***Second law of motion*:** It states that the rate of change of momentum of a body is proportional to the applied unbalanced force in the direction of force.

***Third law of motion*:** It states that when one body exerts a force on another body, the other body also exerts a force on the first body. These forces are always equal in magnitude but opposite in direction.

- **Momentum (*p*):** The momentum of a body is the product of its mass and velocity, *i.e.*,

$$p = mv, \tag{7.1}$$

where *m* is the mass of the body and *v* is its velocity. The direction of momentum is the same as that of velocity. Its SI unit is $kgms^{-1}$.

- **Mathematical form of Newton's second law of motion:** The applied force on a body is

$$F = ma, \tag{7.2}$$

where m is the mass of the body and a is the acceleration of the body.

- The SI unit of force is **$kgms^{-2}$ or newton (N).** A force of 1 N produces an acceleration equal to 1 ms^{-2} on a body of mass 1kg.
- The change in momentum of body is equal to the impulse of the applied force.
- **Impulse**: It is defined as

$$I = Ft, \tag{7.3}$$

where *F* is the force applied on the body for a time interval *t*. The SI unit of impulse is newton-second (Ns).

- **Principle of conservation of momentum**: The total momentum of a system remains constant if no net external unbalanced force acts on the system.
- Total momentum before collision = total momentum after collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \tag{7.4}$$

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