

Lecture 1. BASIC CONCEPTS

1.1 INTRODUCTION

Mechanics is the branch of the physical science which deals with the study of forces behaviour of bodies that are acted upon by forces.

Statics is the study which deals with the condition of bodies in equilibrium subjected to external forces.

In other words, when the force system acting on a body is balanced, the system has no external effect on the body, the body is in equilibrium.

Dynamics is also a branch of mechanics in which the forces and their effects on the bodies in motion are studied.

Dynamics is sub-divided into two parts: (1) Kinematics and (2) Kinetics

Kinematics deals with the geometry of motion of bodies without and application of external forces.

Kinetics deals with the motion of bodies with the application of external forces.

Hydromechanics is the study which deals with the conditions of fluid under which it can remain at rest or in motion. Hydromechanics can be divided into hydrostatics and hydrodynamics.

Hydrostatics is the study of fluid at rest.

Hydrodynamics is the study of fluid in motion.

1.2 SOME BASIC TERMS USED IN MECHANICS

The followings are the basic terms which are used in mechanics:

Particle: It can be defined as an object which has only mass and no size. Such a body cannot exist theoretically.

When we deal with the problems involving distances considerably larger compared to the size of the body, the body may be treated as particle.

Rigid Body: A body is said to be rigid if it retain its shape and size even if the external forces are applied on it. It is called a rigid body.

Mass: The quantity of the matter possessed by a body is called mass. The mass of a body can not change unless the body is damaged and part of it is physically separated.

Length: It is a concept to measure linear distances.

Time: Time is the measure of succession of events. The successive event selected is the rotation of earth about its own axis and this is called a day.

Space: Any geometric region in which the study of a body has been done is called space.

Displacement: It is defined as the distance moved by a body/particle in the specified direction.

Velocity: The rate of change of displacement with respect to time is defined as velocity.

Acceleration: It is the rate of change of velocity with respect to time.

Momentum: The product of mass and velocity is called momentum. Thus

Momentum = Mass \times Velocity

1.3 LAWS OF MECHANICS

The following are the fundamental laws of mechanics:

- i. Newton's first law
- ii. Newton's second law
- iii. Newton's third law
- iv. Newton's law of gravitation
- v. Law of transmissibility of forces
- vi. Parallelogram law of forces

Law of transmissibility of forces and law of parallelogram of forces will be discussed in coming lessons. Let us discuss the remaining laws:

- i. **Newton's first law:** It states that every body continues in its state of rest or of uniform motion in a straight line unless it is compelled by an external agency acting on it.
- ii. **Newton's second law:** It states that the rate of change of momentum of a body is directly proportional to the impressed force and it takes place in the direction of the force acting on it.

According to this law,

Force = rate of change of momentum. But momentum = mass \times velocity

As mass do not change,

Force = mass \times rate of change of velocity

i.e., Force = mass \times acceleration

$F = m \times a$

- iii. **Newton's third law:** It states that for every action there is an equal and opposite reaction.