

Module I: FORCES AND MOMENT

Session 1

Engineering Mechanics

It is that branch of Applied Science, which deals with the laws and principles of Mechanics, along with their applications to engineering problems. It studies the effects of forces on rigid bodies.

It may be divided into the following two main groups: 1. Statics, and 2. Dynamics

Statics

It is that branch of Engineering Mechanics, which deals with the forces and their effects, while acting upon the bodies at rest.

Dynamics

It is that branch of Engineering Mechanics, which deals with the forces and their effects, while acting upon the bodies in motion. The subject of Dynamics may be further sub-divided into the following two branches: 1. Kinetics and 2. Kinematics

Kinetics

It is the branch of Dynamics, which deals with the bodies in motion due to the application of forces.

Kinematics

It is that branch of Dynamics, which deals with the bodies in motion, without any reference to the forces which are responsible for the motion.

Matter, Particle and Body

Matter: Matter is anything that occupies space, possesses mass and offers resistance to any external force.

Particle: A particle is an object that has infinitely small volume (occupies negligible space) but has a definite mass which can be considered to be concentrated at a point.

Body: A body has a definite shape and consists of numbers of particles.

Rigid body: A rigid body exhibits no relative deformation between two parts when it is acted upon by a force system. It means the size and shape of the body does not change under the action of forces, how large they may be.

Elastic body: An elastic body undergoes deformation but regains its original shape and size after removal of the external forces.

Force

Force is an external agency that tends to change the state of rest or of uniform motion of a body. It is a vector quantity and its unit is Newton (N).

Specification of a Force

- Magnitude of the force (*i.e.*, 100 N, 50 N, 20 kN, 5 kN, etc.)

- The direction of the line, along which the force acts (*i.e.*, along OX , OY , at 30° North of East etc.). It is also known as line of action of the force.
- Nature of the force (*i.e.*, whether the force is push or pull). This is denoted by placing an arrow head on the line of action of the force.
- The point at which (or through which) the force acts on the body.

Principle of Transmissibility of Forces

It states, “If a force acts at any point on a rigid body, it may also be considered to act at any other point on its line of action, provided this point is rigidly connected with the body.”

System of Forces

When two or more forces act on a body, they are called to form a *system of forces*. Following systems of forces are important from the subject point of view:

- ***Coplanar forces.*** The forces, whose lines of action lie on the same plane, are known as coplanar forces.
- ***Collinear forces.*** The forces, whose lines of action lie on the same line, are known as collinear forces.
- ***Concurrent forces.*** The forces, which meet at one point, are known as concurrent forces. The concurrent forces may or may not be collinear.
- ***Coplanar concurrent forces.*** The forces, which meet at one point and their lines of action also lie on the same plane, are known as coplanar concurrent forces.
- ***Coplanar non-concurrent forces.*** The forces, which do not meet at one point, but their lines of action lie on the same plane, are known as coplanar non-concurrent forces.
- ***Non-coplanar concurrent forces.*** The forces, which meet at one point, but their lines of action do not lie on the same plane, are known as non-coplanar concurrent forces.
- ***Non-coplanar non-concurrent forces.*** The forces, which do not meet at one point and their lines of action do not lie on the same plane, are called non-coplanar non-concurrent forces.