Engineering Mechanics

Mechanics: Mechanics is a branch of the physical sciences that is concerned with the state of rest or motion of bodies subjected to the action of forces.

(1)Rigid-body Mechanics Statics (2) Dynamics (3) Deformable-Body Mechanics, (4) Fluid Mechanics

Rigid-body Mechanics Statics: deals with equilibrium of bodies under action of forces (bodies may be either at rest or move with a constant velocity).

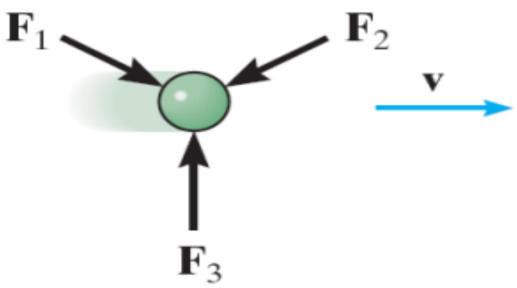
*A rigid body does not deform under load! *

Dynamics: deals with motion of bodies (accelerated motion).

Newton's Three Laws of Motion

First Law: A particle originally at rest, or moving in a straight line with constant velocity, tends to remain in this state provided the particle is not subjected to an unbalanced force.

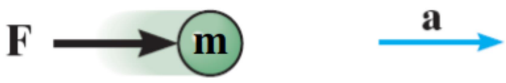
*First law contains the principle of the equilibrium of forces - main topic of concern in Statics .



Equilibrium

Second Law: A particle of mass "m" acted upon by an unbalanced force "F" experiences an acceleration "a" that has the same direction as the force and a magnitude that is directly proportional to the force.

*Second Law forms the basis for most of the analysis in Dynamics

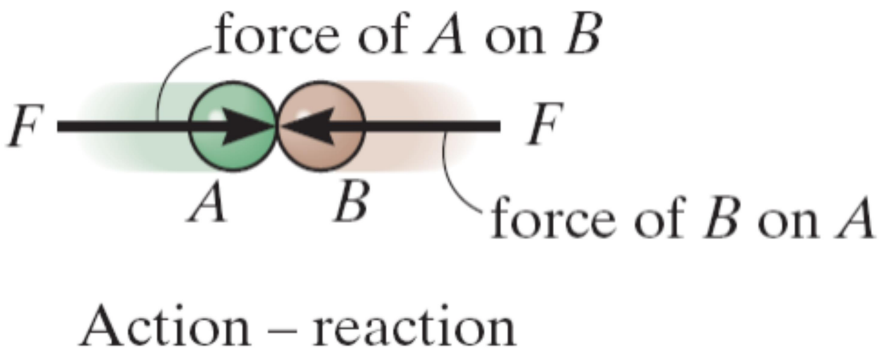


F = ma

Accelerated motion

Third Law: The mutual forces of action and reaction between two particles are equal, opposite, and collinear.

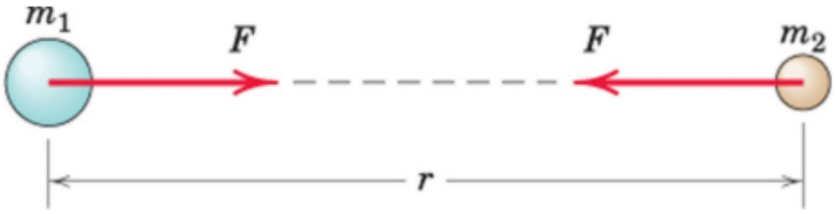
*Third law is basic to our understanding of Force - Forces always occur in pairs of equal and opposite forces.



Action – reaction

Newton's Law of Gravitational Attraction

Weight of a body (gravitational force acting on a body) is required to be computed in Statics as well as Dynamics. This law governs the gravitational attraction between any two particles.



F=G. $\frac{m_1 m_2}{r^2}$

F = mutual force of attraction between two particles

G = universal constant of gravitation (Experiments - G = 6.673x10-11 m3/(kg.s2)

Rotation of Earth is not taken into account

m1, m2 = masses of two particles r = distance between two particles.

Force Systems Force

Magnitude (P), direction (arrow) and point of application (point A) is important Change in any of the three specifications will alter the effect on the bracket.

Force is a Fixed Vector

In case of rigid bodies, line of action of force is important (not its point of application if we are interested in only the resultant external effects of the force), we will treat most forces as

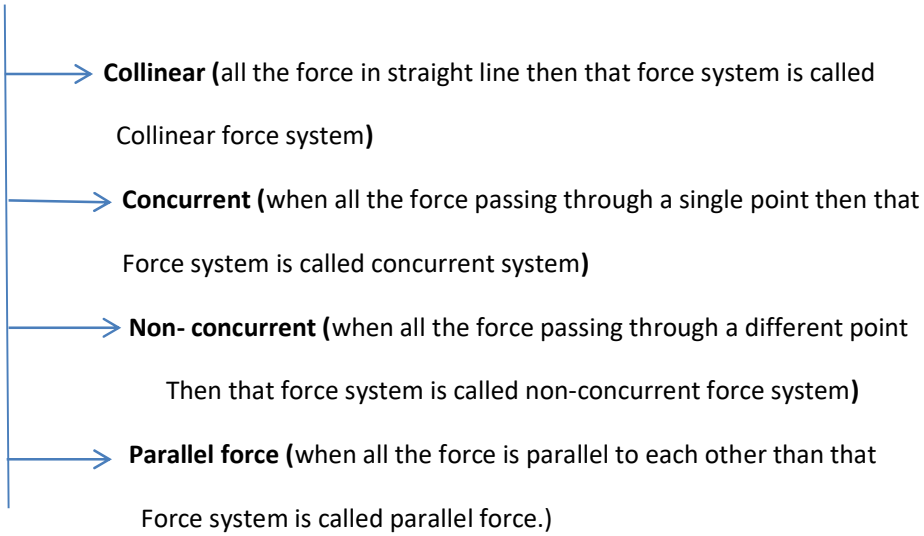
Force system

Coplanar force

(When all the force lies in a single plane then That force system is called coplanar**)**

Non-coplanar force

(when all the force lies in different plane that force system is called non- coplanar force system)



Concurrent force: Forces are said to be concurrent at a point if their lines of action intersect at that point F1, F2 are concurrent forces; R will be on same plane; R = F1+F2