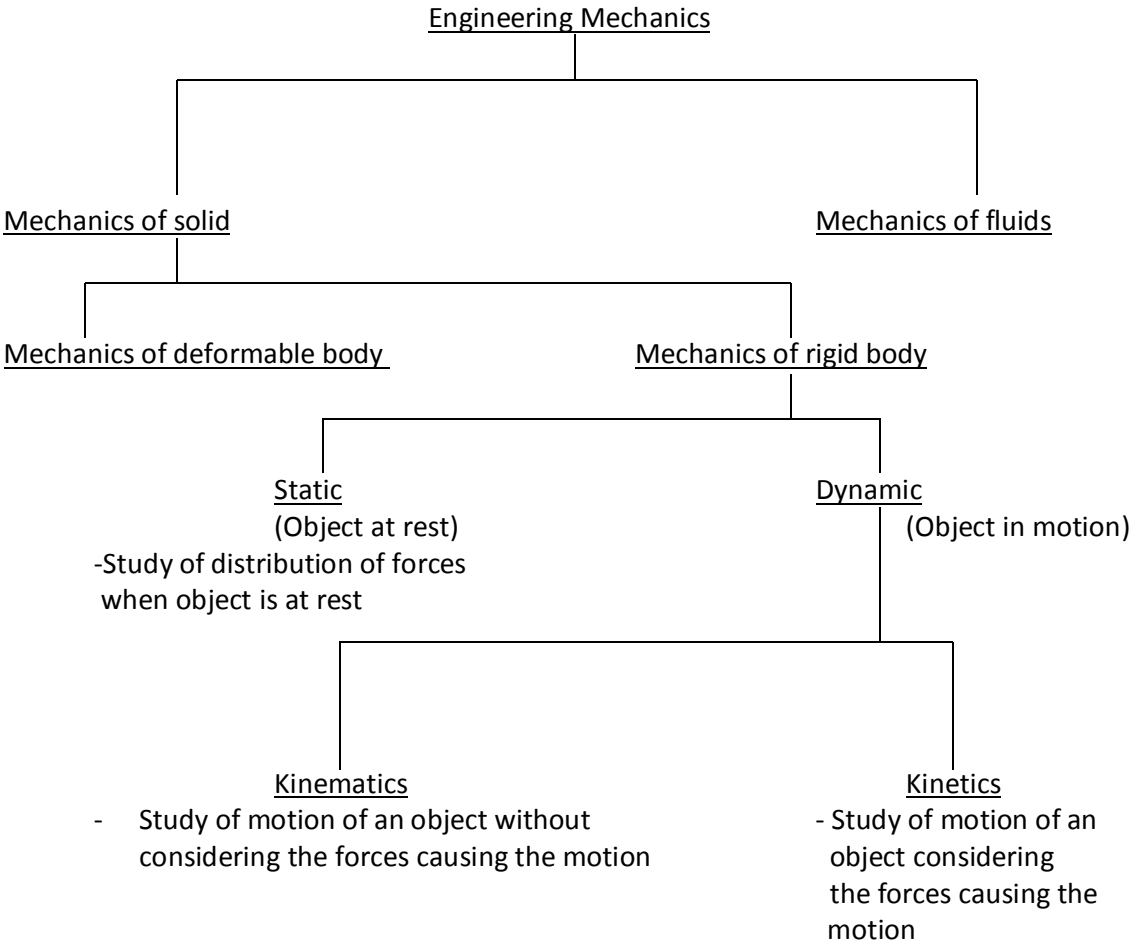
1.1 Introduction

Engineering Mechanics-

It is a branch of physical science which is concerned with the static and dynamic behavior of the object in presence of an external effect.

(or)

It can be defined as a branch of physical science which is concerned with the state of rest or motion of the object that is subjected to an external effect. The categorization of the engineering mechanics is as follows:



Quantity: It is a property that gives the amount of any measurable characteristic. This can be categorized as a scalar quantity or a vector quantity.

Mass: It is the property of matter. It provides the quantitative measure of resistance of the matter to a change in its motion. It is a scalar quantity.

Body: It is a distinct mass, where the matter is continuously distributed in a defined shape of volume V which is enclosed within the surface S.

Particle: When the dimensions of a body are considered to be negligible and are irrelevant to the description of its motion, then the body can be termed as a particle. It has mass with size being negligible. When the body is idealized as a particle, the geometry of the particle will not be involved in the analysis of the problem as such the principles of mechanics will be reduced to simplified form.

Rigid body: When the dimensions of a body does not change during the course of events of an action, then the body is called as a rigid body. It is considered as a combination of a large number of particles in which all the particles remain at a fixed distance from one another before and after applying the load. In most cases the actual deformation or yielding occurring in structures, mechanisms etc. is relatively small.

Deformable body:

When the dimensions of a body change during the course of events of an action, then the body is called as a deformable body.

Scalar quantity:

A quantity which is characterized by a positive or negative number is called a scalar quantity. It has only magnitude. For e.g. mass, temperature, time etc.

Vector quantity:

A quantity which has both magnitude and direction is called as a vector quantity. For e.g. displacement, velocity, acceleration, force, momentum etc. A vector quantity is generally represented with an arrow over it $\vec{A}$ or $\overline{A}$. Its magnitude is represented as $|A|$. A vector is represented by an arrow, which is used to define its magnitude and direction. The magnitude of the vector is the length of the arrow and the direction is defined by the angle between reference axis and arrow.

Unit vector: It is a vector which is having a unit magnitude and direction, i.e. $|A|$ = 1 or A=1.

Multiplication of vector by scalar:

The product of a vector $\overline{A}$ and scalar 'a', is given by $a\overline{A}$. If 'a' is positive quantity then the direction of the vector $a\overline{A}$ remaining same as $\overline{A}$. If 'a' is negative quantity then the direction of the vector $a\overline{A}$ will be opposite to $\overline{A}$.

Fluid: A substance which deforms continuously under the application of shear stress is called as fluid. A fluid can be liquid or gas.

Solid: A substance or an object which is having a preferred configuration of its own i.e. possessing a definite surface and a definite volume.

Length: It is needed to locate the position of a point in space. It is the property which is used to measure the dimensions or distance. It is a scalar quantity.

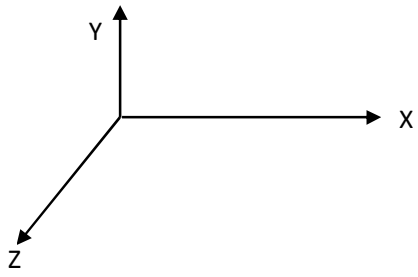
Time: It is defined as the measurable period or duration. It is a scalar quantity.

Weight: It is defined as the force with which a body is attracted towards the center of earth. It can be written as W = Mg. It is a vector quantity.

∀ M is mass of the body
g = acceleration due to gravity
= 9.81m/s^2

Vector-

In many engineering problems, including physics, mathematics and mechanics, there is a need to choose some reference system in order to solve the problem. Here the co-ordinate system X, Y and Z axis is selected as reference system for the purpose of calculations. In vector algebra we use the concept of unit vectors $\bar{i}$, $\bar{j}$, $\bar{k}$ which are oriented in the direction of X, Y and Z axis respectively as shown in the fig.1.1.



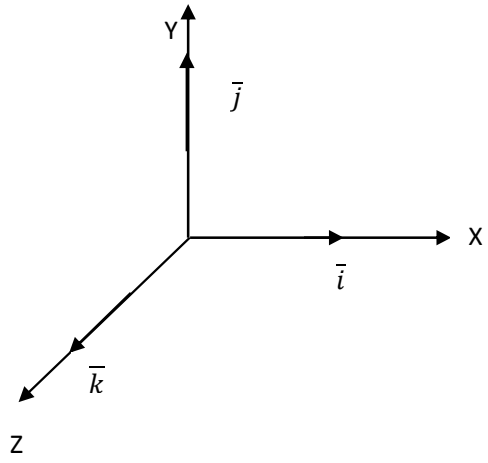


Fig. 1.1

When these unit vectors are multiplied by some scalar then we get a vector which is acting along the axis and has some magnitude. A vector of magnitude 5 units acting along X- axis is represented as $5\bar{i}$ as shown in the fig.1.2.

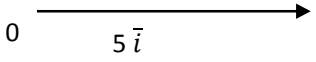


Fig. 1.2