SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
Department of Mechatronics Engineering

LEARNING OBJECTIVES OF VECTORS

- To define scalars, vectors and types of vectors
- To study the representation of vectors in Cartesian co-ordinates
- To understand vector operations
- To define a force and moment
- To study the representation of forces and moments in Cartesian co-ordinates
- To solve problems in vectors
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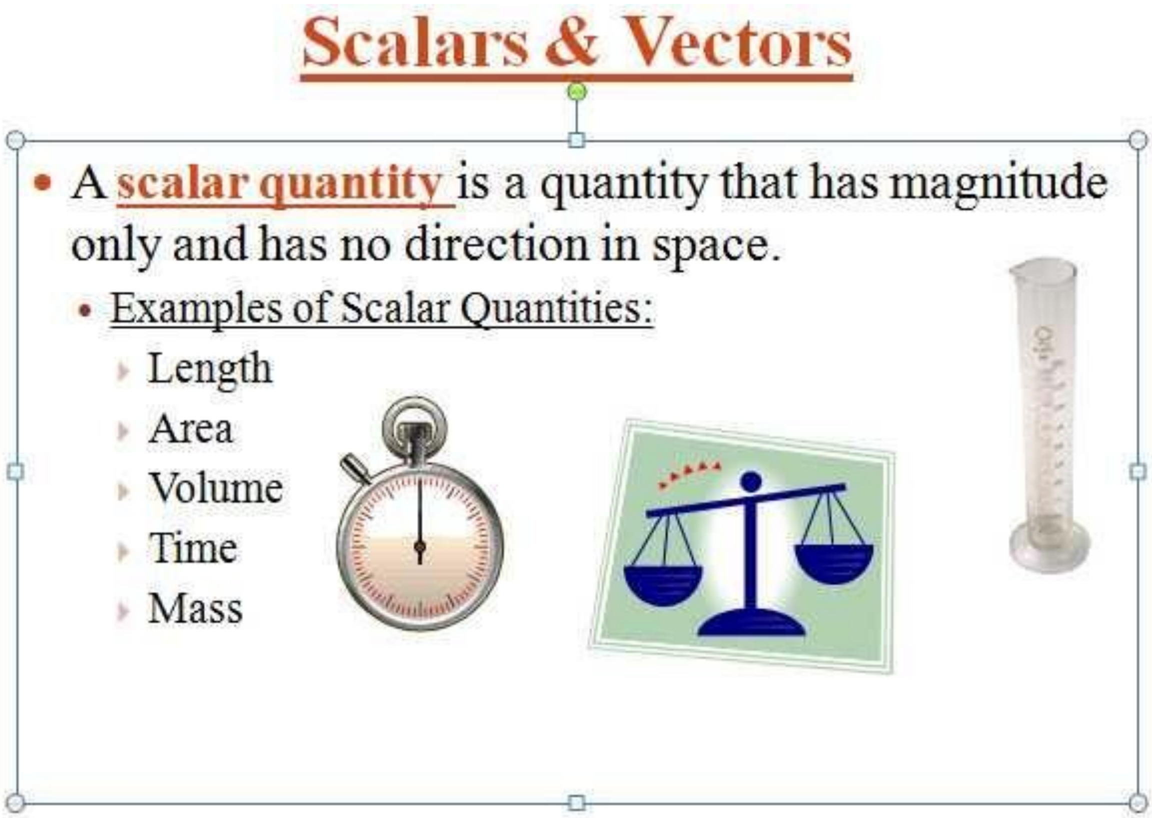
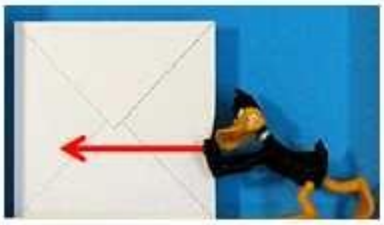


- A **vector quantity** is a quantity that has both magnitude and a direction in space
  - Examples of Vector Quantities:
    - Displacement
    - Velocity
    - Acceleration
    - Force
    - Moment
    - Couple



Vectors

- A **vector quantity** may not be understood (meaningless), if the direction isnot properly assigned.

Types of Vectors

- **Free Vector** – Can be moved to anywhere in space.
- **Sliding Vector** – can be applied any point along its line of action
- **Fixed Vector / Bound Vector** – can't be moved and remains at the samepoint.
- **Unit Vector** – magnitude is one unit.
- **Negative Vector** – vector with same magnitude but opposite in sense.
- **Zero Vector / Null Vector** – can be obtained by adding with its negativevector.

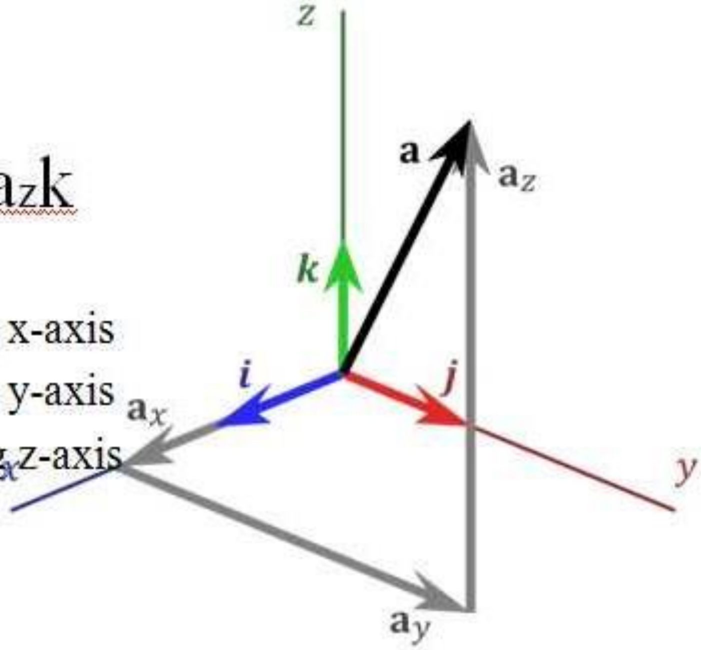
Representation of Vectors in Cartesian Co-ordinate

From origin,

$$\bar{a} = a_x i + a_y j + a_z k$$

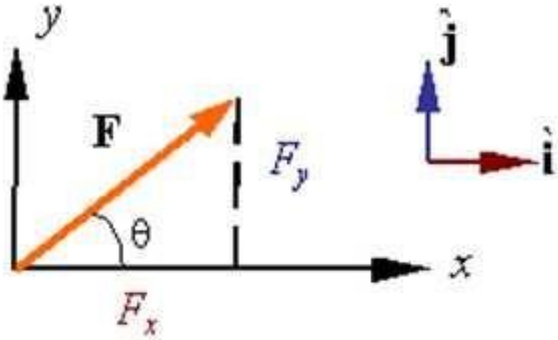
Where,

- 'i' is unit vector along x-axis
- 'j' is unit vector along y-axis
- 'k' is unit vector along z-axis



Vectorial Representation of a Force in 2D

Consider the force **'F'** in Two Dimensional plane,



$$\tan(\theta) = \frac{F_y}{F_x}$$

Then,

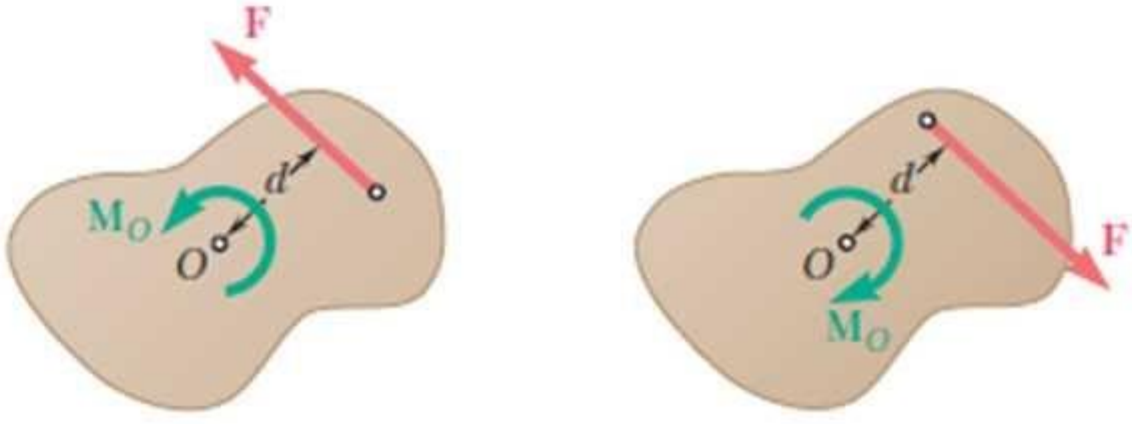
$$\mathbf{F} = F_x\hat{\mathbf{i}} + F_y\hat{\mathbf{j}}$$

$$F = \sqrt{F_x^2 + F_y^2}$$

$$F_x = F\cos(\theta)$$

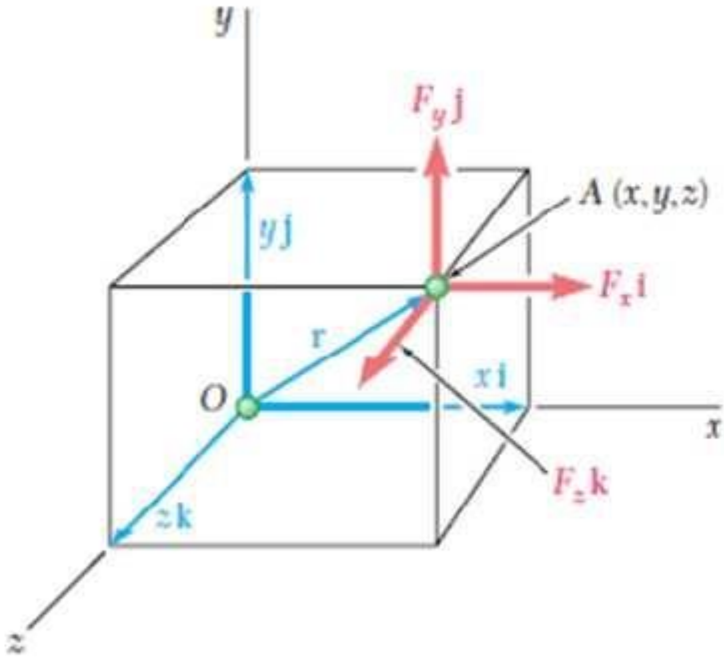
$$F_y = F\sin(\theta)$$

Vectorial Representation of Moment in 2D



(a) $M_O = +Fd$ (b) $M_O = -Fd$

Moment about Origin:



$$\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$$
$$\mathbf{F} = F_x\mathbf{i} + F_y\mathbf{j} + F_z\mathbf{k}$$

$$\mathbf{M}_O = \mathbf{r} \times \mathbf{F}$$

$$\mathbf{M}_O = M_x\mathbf{i} + M_y\mathbf{j} + M_z\mathbf{k}$$

$$\mathbf{M}_O = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ x & y & z \\ F_x & F_y & F_z \end{vmatrix}$$