Chapter 1

VECTOR ALGEBRA

1.1 Basic Review of Vectors

■ Definition:

Physical quantities having both magnitude and a definite direction in space. It should follow the law of vector addition.

Example: Velocity, Acceleration, Momentum, Force, Electric Field, Torque, etc.

Note: Current is a physical quantity that has both magnitude and direction but it does not follow the law of vector addition. So, current is a scalar quantity.

■ Various type of vectors:

(1) Equal vectors: Vectors having same magnitude and same direction.

(2) Null Vectors: Vectors having coincident initial and terminal point i.e. its magnitude is zero and it has any arbitrary direction.

(3) Unit Vector: Vector having unit magnitude. Unit vector along $\vec{a}$ is $\hat{a} = \frac{\vec{a}}{|\vec{a}|}$

(4) Reciprocal Vector: Vector having same direction as $\vec{a}$ but magnitude reciprocal to that of $\vec{a}$, is known as the reciprocal vector of $\vec{a}$. Reciprocal vector of $\vec{a}$ is $\vec{a}^{-1} = \frac{1}{|a|}\hat{a}$

(5) Negative Vector: Vectors having same magnitude as $\vec{a}$ but direction opposite to that of $\vec{a}$, is known as the negative vector of $\vec{a}$. Negative vector as $\vec{a}$ is $-\vec{a} = -|a|\hat{a}$

■ Orthogonal Resolution of Vectors:

Any vector $\vec{A}$ in the 3-D right- handed rectangular cartesian coordinate system can be represented as

$$\overrightarrow{OP} = \vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k},$$

where, $\hat{i}, \hat{j}$ and $\hat{k}$ are the unit vectors in direction of x, y and z axis respectively and A_x, A_y, A_z are the rectangular components of vector $\vec{A}$ along x, y, z axis.

Magnitude of vector $\vec{A}$ is $|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$

Unit vector along $\vec{A}$ is $\hat{A} = \vec{A}/|\vec{A}| = \left(A_x\hat{i} + A_y\hat{j} + A_z\hat{k}\right)/\sqrt{A_x^2 + A_y^2 + A_z^2}$