## Work Done by a Variable Force.

When the magnitude and direction of a force varies with position, the work done by such a force for an infinitesimal displacement is given by  $dW = \vec{F} \cdot d\vec{s}$ 

The total work done in going from A to B as shown in the figure is

$$W = \int_{A}^{B} \vec{F} \cdot d\vec{s} = \int_{A}^{B} (F \cos\theta) ds$$

In terms of rectangular component  $\vec{F} = F_x \hat{i} + F_y \hat{j} + F_z \hat{k}$ 

$$d\vec{s} = dx\hat{i} + dy\hat{j} + dz\hat{k}$$
  
$$\therefore W = \int_{A}^{B} (F_{x}\hat{i} + F_{y}\hat{j} + F_{z}\hat{k}).(dx\hat{i} + dy\hat{j} + dz\hat{k})$$
  
or  $W = \int_{x_{A}}^{x_{B}} F_{x}dx + \int_{y_{A}}^{y_{B}} F_{y}dy + \int_{z_{A}}^{z_{B}} F_{z}dz$ 

