

## PH-105 Assignment Sheet - 3 (Quantum Mechanics - 2)

Umang Mathur

**48. Find the angular momentum operator in Cartesian co-ordinate system**

**Solution** :

The angular momentum operator is defined as follows:

$$\hat{\mathbf{L}} = \hat{\mathbf{r}} \times \hat{\mathbf{p}}$$

where,  $\hat{\mathbf{r}} = r$  and  $\hat{\mathbf{p}} = -i\hbar\hat{\nabla}$ . Hence,

$$\hat{\mathbf{L}} = -i\hbar(x\hat{i} + y\hat{j} + z\hat{k}) \times \left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right)$$

$$\text{Therefore, } \hat{\mathbf{L}} = -i\hbar\left((y\frac{\partial}{\partial z} - z\frac{\partial}{\partial y})\hat{i} + (z\frac{\partial}{\partial x} - x\frac{\partial}{\partial z})\hat{j} + (x\frac{\partial}{\partial y} - y\frac{\partial}{\partial x})\hat{k}\right)$$