RADIATION FROM A SMALL CURRENT ELEMENT

- An alternating current element or oscillating current dipole possesses electromagnetic field.

- We will find these fields everywhere around using the concept of Retard Vector Potential.

- Let the elemental length ***(dl)*** of the wire be placed at the origin of the spherical co-ordinate and ***I*** be current flowing through it as shown in the figure 2.20.
- The length is so short that current is constant along the length.

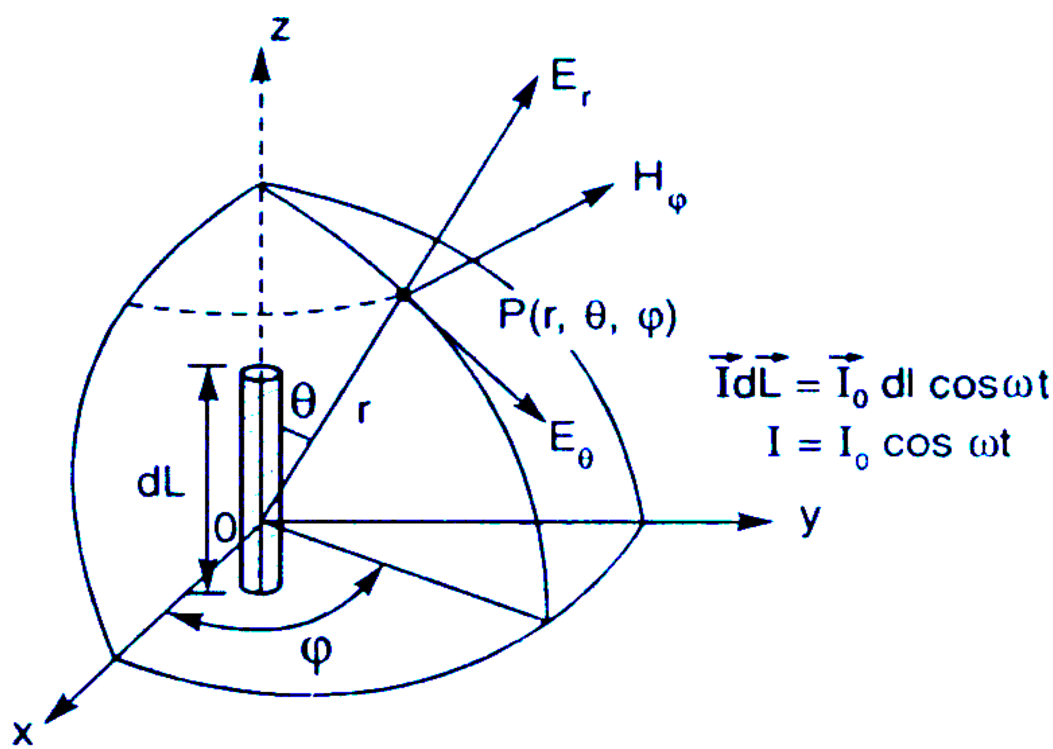

Fig. 2.20. Current element (***Idl***) at the origin of sphere

Magnetic Field Components

- To find the electromagnetic field at any arbitrary point $P(r, \theta, \phi)$ first we will calculate the vector potential $\vec{\mathbf{A}}$
- The general expression for magnetic vector potential is given by

$$\vec{\mathbf{A}}(r) = \frac{\mu}{4\pi} \int \frac{\vec{\mathbf{J}}\left(t - \frac{r}{c}\right)}{r} \, dv \qquad \text{....(2.169)}$$

- The vector potential $\vec{A}$ is acting along z direction so it will have only z component

e.g., A_z retarded in time by (r/c) seconds.

- Since the current element is excited by the current *I*

I = $I_0 \cos \omega t$, so $\int_V \vec{J}\, dv$ in Eqn. (2.169) may be replaced by *Idl*

thus

$$\vec{A}_z = \frac{\mu}{4\pi} \int \frac{I_0\, dL \cos\omega\left(t - \frac{r}{c}\right)}{r}$$

$$A_z = \frac{\mu}{4\pi} \int_V \frac{\vec{J}\left(t - \frac{r}{c}\right) dv}{r}$$

$$= \frac{\mu}{4\pi} \int_V \frac{\vec{J}\left(t - \frac{r}{c}\right) \vec{ds}\ \vec{dl}}{r} = \frac{\mu}{4\pi} \int \frac{I\left(t - \frac{r}{c}\right)}{r} \qquad \text{...(2.170)}$$