

Magnetostatics

Magnetic Flow Density

From point dipole $\mathbf{m} = m\mathbf{e}_z$:

$$\mathbf{B}(\mathbf{r}) = \frac{\mu_0 m}{4\pi r^3} (2 \cos \theta \mathbf{e}_r + \sin \theta \mathbf{e}_\theta)$$

From current density $\mathbf{J}_{tot}(\mathbf{r}')$:

$$\mathbf{B}(\mathbf{r}) = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}_{tot}(\mathbf{r}') \times \mathbf{e}_R}{R^2} dv'$$

where $\mathbf{J}_{tot} = \mathbf{J} + \mathbf{J}_m$. From current line:

$$\mathbf{B}(\mathbf{r}) = \frac{\mu_0}{4\pi} \int \frac{I dl' \times \mathbf{e}_R}{R^2}$$

From circular thread loop:

$$\mathbf{B}(x = 0, y = 0, z) = \frac{\mu_0 I}{2} \frac{b^2}{(b^2 + z^2)^{3/2}} \mathbf{e}_z$$

From coil:

$$\mathbf{B} = \frac{\mu_0 N I}{\ell} \frac{\cos(\alpha_2) - \cos(\alpha_1)}{2} \mathbf{e}_z$$

From long straight current path:

$$\mathbf{B}(\mathbf{r}) = \frac{\mu_0 I}{2\pi r_c} \mathbf{e}_\varphi$$