Magnetostatics

Magnetic Flow Density

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

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

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

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

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

$$\boldsymbol{B}(\boldsymbol{r}) = \frac{\mu_0}{4\pi}\int \frac{I\, d\boldsymbol{l}' \times \boldsymbol{e}_R}{R^2}$$

From circular thread loop:

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

From coil:

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

From long straight current path:

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