1.4: The Auxiliary Fields D and H

It is sometimes useful to rewrite Maxwell's equations (1.2.1 to 1.2.4 in terms of $\vec{E}$, $\vec{B}$, and two new vector fields $\vec{D}$and $\vec{H}$. These two new vectors are constructed as follows:

$$\overrightarrow{\mathrm{D}} = \epsilon_0 \overrightarrow{\mathrm{E}} + \overrightarrow{\mathrm{P}}$$

and

$$\overrightarrow{\mathrm{B}} = \mu_0(\overrightarrow{\mathrm{H}} + \overrightarrow{\mathrm{M}})$$

When written using these two new fields Maxwell's equations become

$$\mathrm{curl}(\overrightarrow{\mathrm{E}}) = -\frac{\partial \overrightarrow{\mathrm{B}}}{\partial t} \tag{1.4.1}$$

$$\mathrm{div}(\overrightarrow{\mathrm{B}}) = 0 \tag{1.4.2}$$

$$\mathrm{curl}(\overrightarrow{\mathrm{H}}) = \overrightarrow{\mathrm{J}}_f + \frac{\partial \overrightarrow{\mathrm{D}}}{\partial t} \tag{1.4.3}$$

$$\mathrm{div}(\overrightarrow{\mathrm{D}}) = \rho_f \tag{1.4.4}$$

Maxwell's equations have a simpler form when written in this way, and may in consequence be easier to remember. Their physical content is, of course, unaltered by the introduction of the two new auxiliary fields $\vec{D}$ and $\vec{H}$.