Lecture 26 (3/18/05)

Magnetostatics

8. Effective current density

$$\vec{J}_M = \vec{\nabla} \times \vec{M}$$

$$\vec{H} = \vec{B} - \vec{M}$$

$$\vec{\nabla} \times \vec{H} = \vec{J} = \text{free current}$$

$$\vec{B} = \mu \vec{H} \text{ linear}$$

$$\vec{B} = \vec{F}(\vec{H}) \text{ ferromagnets}$$

9. Mapping to electrostatics

$$-\vec{\nabla} \cdot \vec{A} = 0$$

$$-\nabla^2 \vec{A} = \mu \vec{J}$$

If $\vec{J} = 0$ and μ is uniform,

$$-\mu \nabla^2 \Phi_M = 0.$$

If $\vec{J} = 0$ and $-\vec{\nabla}\vec{M} \neq 0$,

$$\Phi_M = \frac{-1}{4\pi} \int \frac{\vec{\nabla}' \cdot \vec{M}(\vec{x}')}{|\vec{x} - \vec{x}'|} d^3x'$$

10. Examples