EELE 250: Circuits, Devices, and Motors

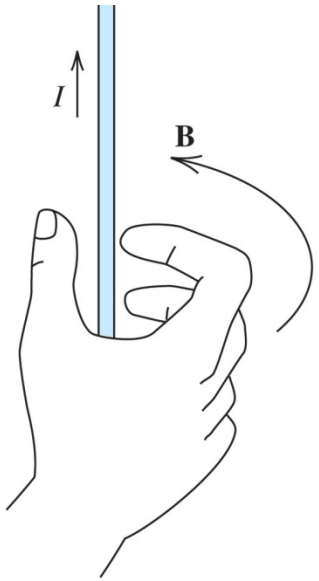
Magnetic Field and Inductance

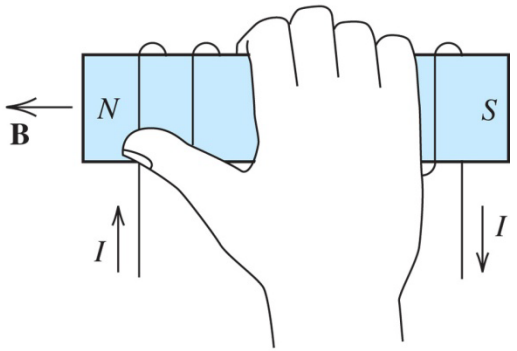
Assignment Reminder

- Read Chapter 15
- No quiz this week.
- Practice problems assigned soon.
- No lab this week. Lab #8 will be next week.

Magnetic Field Principles

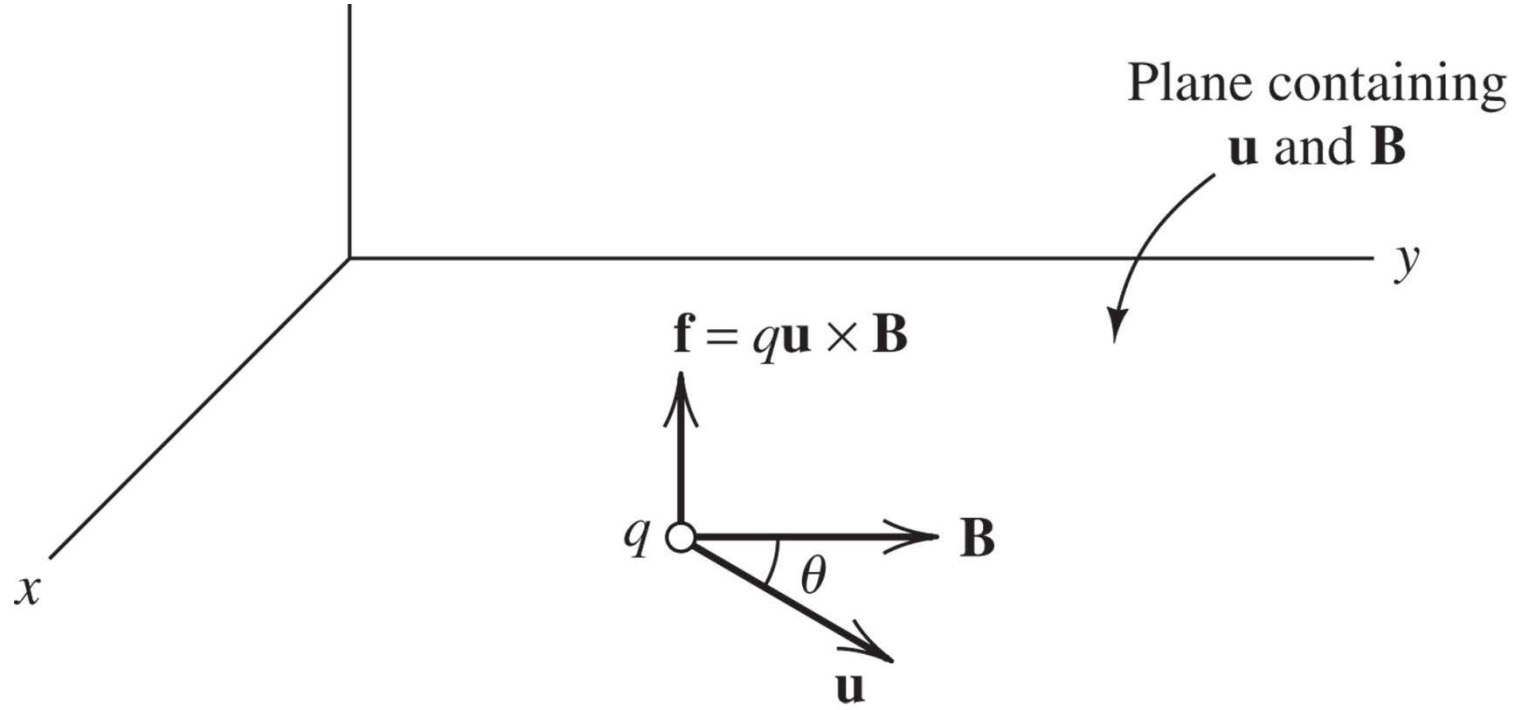
- A wire carrying a current creates a magnetic field oriented in a right-handed fashion.
- A coil of wire creates a magnetic field oriented in a right-handed fashion.
- Magnetic field B is Wb/m^2 = tesla (T)





Magnetic Fields and Moving Charge

- An electrical charge *q* moving with velocity **u** through a magnetic field **B** experiences a force **f** given by: **f** = q**u x B** . And: f = quB sin(Θ)



Flux Linkages

- The flux density B results in a total magnetic flux ϕ passing through a given area.
- The flux passing through a surface A normal to B is $\phi = B\,A$.
- If we have a tightly wrapped coil of wire, the flux *linkages* (λ) passing inside the coil is
  $\lambda = N\,\phi$,
  where N is the number of “turns” in the coil.

Faraday's Law

- Magnetic induction voltage:

$$e = \frac{d\lambda}{dt}$$

This means that a voltage *e* is induced in a coil whenever its flux linkages are *changing*.

- The induced voltage polarity opposes the change in flux linkages.

Reluctance and Inductance

- The *reluctance* of a path carrying a magnetic flux is

$$R = \frac{l}{\mu A}$$

- l is the path length
- A is the cross sectional area
- μ is the magnetic permeability of the material
- The inductance $\mathrm{L} = N^2 / R = \lambda / i$