Induction

Equipment

- DMM, oscilloscope, function generator and step-down transformers.
- Solenoid, magnets, battery eliminator and connectors (BNC, banana and alligator)
- Inductive brake, inductive wand with gap magnet. St. Louis motors.
- Demo apparatus: jumping ring and conductive pipe with rare-earth magnet

Objective

Physics Concepts

- Magnetic field flux and induced currents

Experimental analysis

- Graph time varying functions, combine measurements to graph new quantities
- Fit curves to data to determine mathematical relationships
- Recognizing the uncertainty in measurements

Conceptual (C-Level)

Draw a diagram and explain the physics for the following apparatus:

- Inductive brake – where a conducting plate is swung through a magnetic field
- A rare-earth magnet falling down a conductive pipe
- Jumping ring – where a ring placed on a solenoid jumps when power is applied

EXPLORATIONS:

- Try out each of the above apparatus and evaluate your conceptual diagrams and explanations.
- Using a solenoid and magnet create a time varying voltage signal that can be observed on an oscilloscope and with a computer probe. Can you make the signal "sinusoidal"?
- Using the oscilloscope determine the frequency and amplitude of some test signals output from the function generator. Play with different waveforms.
- Explore all aspects of "Faraday's Electromagnetic Lab" simulation.

Basic Lab (B-Level)

You will be measuring time varying voltage signals.

- Using a rotary motion sensor and the inductive wand determine the voltage as a function of position for the coil of wire as it swings through a magnetic field.
- Use an oscilloscope to determine the amplitude and frequency for the output from the step-down transformer. Compare with DMM voltage reading.
- Determine the voltage signal from a Hall Effect probe positioned near a working St Louis motor. Make sure to include a diagram of your setup and expected DC and AC signals. Note: Use the simulation to determine what to expect when you create a generator.

Advanced/Extended Lab Ideas (A-Level)

- Determine the terminal velocity of magnet in free-fall through conductive pipe. Compare theory to experiment.
- Can you measure a signal in a solenoid surrounding a conductive pipe when a magnet is dropped through the pipe?
- Determine the motor frequency as a function of current through electromagnet in a St Louis motor.
- Voltage signal from a solenoid positioned near a working St Louis motor (this is hard).