

Chapters 12~14

Magnetism and Inductors



Source: Circuit Analysis: Theory and Practice ©Delmar Cengage Learning



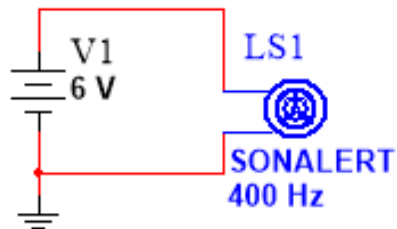
The Nature of a Magnetic Field

- **Magnetism**
 - Force of attraction or repulsion that acts between magnets and other magnetic materials
- **Flux lines**
 - Show direction and intensity of this field at all points
- **Field is strongest at poles**
 - Direction is from N to S



C-C Tsai

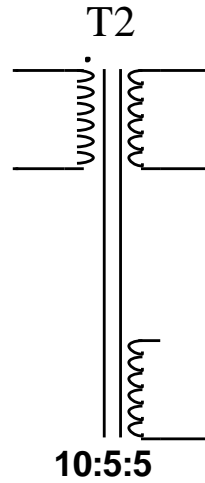
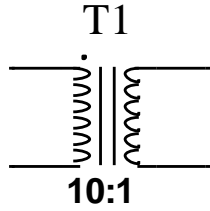
Application: Loudspeaker



Magnetic Circuits

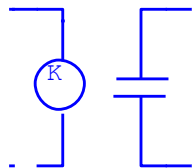
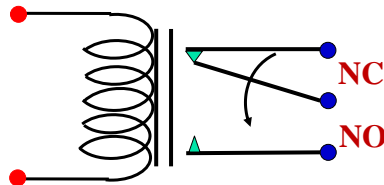
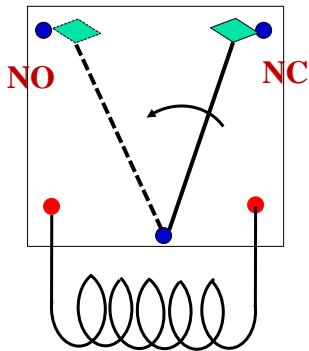
- Found in **motors, generators, speakers, transformers**
- Magnetic fields can be created by electric currents and permanent magnets
- Magnetic stripe containing information
 - Used in bank **ATM cards**, library cards, etc.
 - Magnetic patterns encode information
 - Reader sees varying magnetic field
 - **Induces a voltage** in the **pickup winding**
 - Voltage is amplified and sent to decoding circuitry
- **MRI (Magnetic Resonance Imaging)** machine uses superconductor coils
 - Create intense magnetic field

Transformers

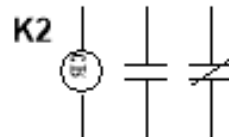


Magnetic Applications

DC-5V Relay

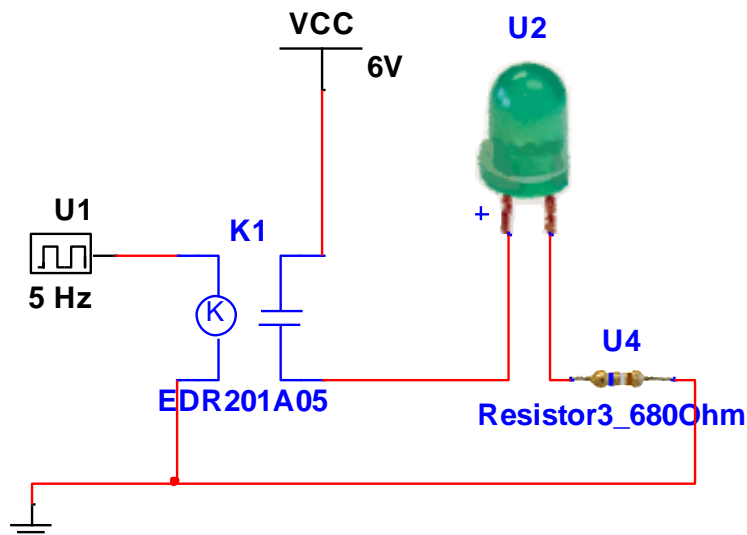


Basic relay in Msim



Electromechanical coils-relay in Msim

Relay



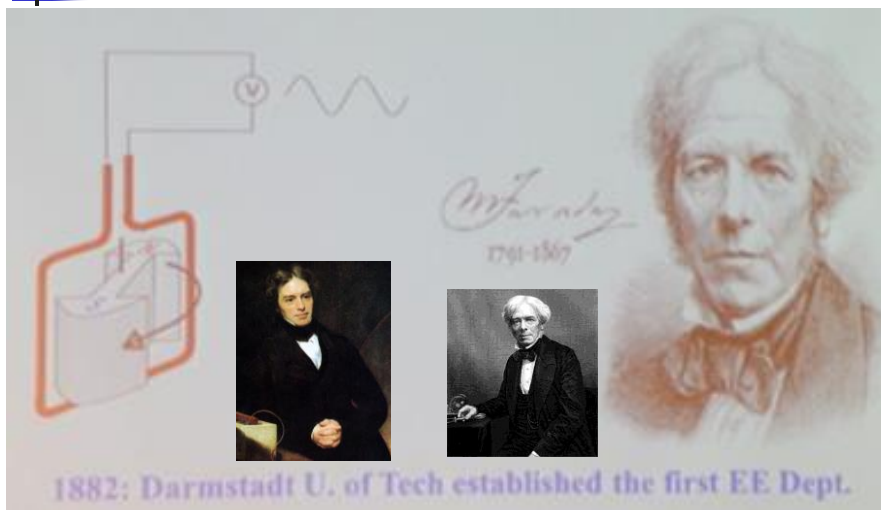
Ch 13 Inductors & Inductance

- Common form of an inductor is a coil of wire
 - Used in radio tuning circuits
- Type of core depends on intended use and frequency range
- For audio or power supply applications
 - Inductors with iron cores are generally used
- **Iron-core inductors**
 - Large inductance values but **have large power losses at high frequencies**
- For high-frequency applications
 - **Ferrite-core inductors** are used

Inductances in Series / Parallel

- For inductors in series
 - **Total inductance** is sum of individual inductors (similar to resistors in series)
- Inductors in parallel add as resistors do in parallel

Electromagnetic Induction



Electromagnetic Induction

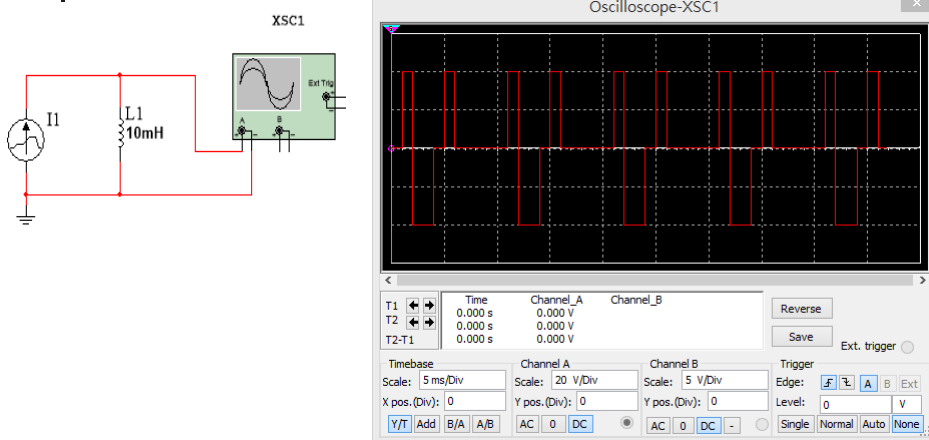
■ Faraday's Law

- **Voltage is induced** in a circuit whenever the flux linking the circuit is changing
- Magnitude of voltage is proportional to rate of change of the flux linkages with respect to time

■ Lenz's Law

- **Polarity** of the induced voltage **opposes** the cause producing it

Simulation in Multisim



Energy Stored by an Inductance

- When energy flows into an inductor and **energy is stored in its magnetic field**
- When the field collapses and energy returns to the circuit
- **No power is dissipated**, so there is **no power loss**

Ch 14 Inductive Transients

- **Capacitive circuit**
 - Transitional phase is based on **capacitor charging and discharging**
 - **Capacitor voltage V_C** cannot change instantaneously and begins at zero and **exponentially increases to E**
- **Inductive circuit**
 - Transitional phase occurs as the **magnetic field builds and collapses**
 - **Inductor current I_L** cannot change instantaneously and begins at zero and **exponentially increases to E/R**