The Electric Circuit
Objective of the Lecture

- Describe a basic electric circuit, which may be drawn as a circuit schematic or constructed with actual components.
Basic Circuit

- A circuit contains one or more power supplies – voltage or current sources – that generate the energy required to force charge to move through the other components in the circuit.

- The other components in the circuit can include:
  - Resistors, inductors, and capacitors
  - Switches
  - Protective devices

- Wires are used to connect the power supplies and components together.

- There is always an electrical ground.
Circuit Schematic

- A schematic is a graphical representation of the physical components used to construct the circuit.
- We have already seen the graphical symbols used for voltage and current sources and resistors.
- The connections between the components are shown in the schematic, which can be followed by an engineer or technician when they build the circuit.
- Several software programs are available with graphical user interfaces so that circuit schematics can be drawn electronically. The layout of the components can be interpreted by some of these programs, which can be used to calculate the operation of the circuit.
Switches

- Switches are used to control whether a complete path is formed from an end of at least one power supply to the other end of the same power supply (closed circuit).
  - Current will only flow when there is a closed circuit.
- Switches can be mechanical, as are used on light switches in your home, or are electronic switches, which are semiconductor based. Electronic switches are used in TV sets, for example, to turn on the TV when an infrared optical signal from the remote control is detected.
Protective Devices

- Circuits that have carry dangerous levels of current and voltages are required to include fuses, circuit breakers, or ground fault detectors by federal and state electrical safety codes.

- These protective devices are designed to create an open circuit, or a break in the round trip path in the circuit, when a malfunction of a component or other abnormal condition occurs.

- The speed of response of the protective device, fast-acting or time-delay (slow-blow) is determine by the engineer, based upon the expected type of malfunction.
Wires

- Wires are assumed to have zero resistance; i.e., they are ideal conductors or short circuits.
  - The current carrying capability of a wire is determined by its diameter or cross-sectional area.
  - AWG, American wire gauge, is the standard followed in the US and is used to rate how much current a wire can safely carry.
    - The larger the gauge wire, the smaller its current carrying capability is.
    - 12 or 14 gauge wire is used in homes.
    - 20-24 gauge wire is used by our ECE students in our circuits labs.
Ground

- Earth ground is a ground that is physically connected to the earth, itself.
  - All homes have an earth ground – a wire connected to a metal pipe that is driven into the ground immediately next to the house. Wires that have a green jacket or are bare copper are connected to this pipe.

- Reference ground or common is used in a circuit to indicate a point where the voltage in the circuit is equal to zero.
Summary

- Several components that can be used to construct a circuit have been reviewed.
  - There are federal and state safety codes that must be followed when designing and constructing a circuit.
  - Standards have been written to determine the current carrying capability of wire used in circuits.
  - A ground in a circuit indicates the point where the voltage is zero.