MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

# Class 02
# Electrical Fundamentals



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MECH 10
Fundamentals of Electronics

Mechatronics
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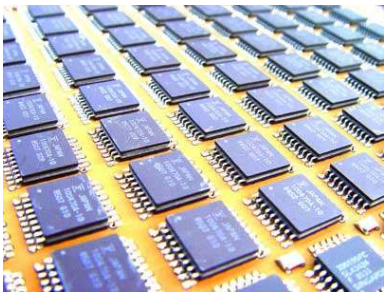
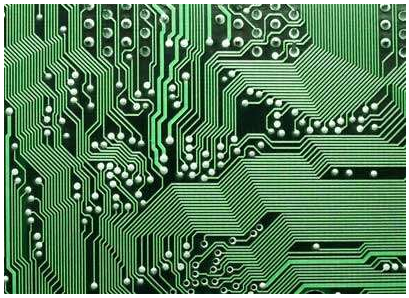
- Electricity
  - Electronics – devices used to control the flow of electrons in a circuit.





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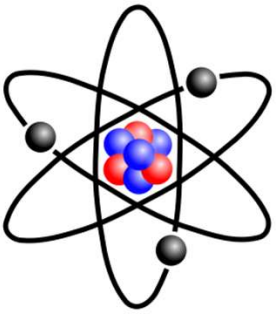
- Electricity
  - Atomic Structure
    - Niels Bohr – “On the Constitution of Atoms and Molecules”
    - Nucleus – uncharged neutrons, positively charged protons
    - Electrons – negatively charged, orbiting the nucleus as a diffused cloud
    - Electron charge = negative proton charge (1.60 x $10^{-19}$ Coulombs)



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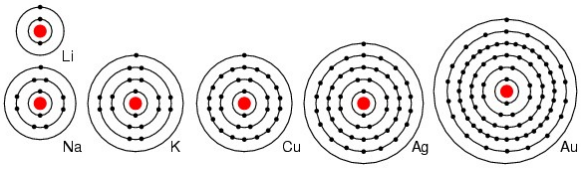
- Electricity
  - Valence Electrons - Conductors
    - Contained in the outermost band
    - Atoms with single valence electron make excellent conductors

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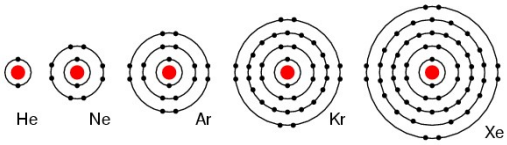
- Electricity
  - Valence Electrons - Insulators
    - Contained in the outermost band
    - Atoms with seven or eight valence electrons atoms make excellent insulators

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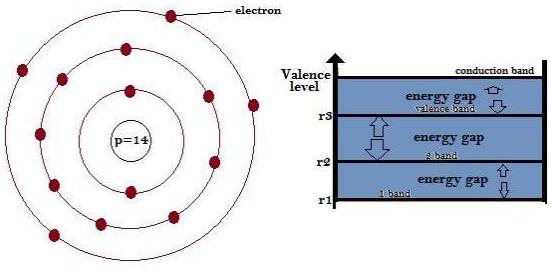
- Electricity
  - Valence Electrons – Semi Conductors
    - Contained in the outermost band
    - Atoms with four valence electrons atoms conduct under certain conditions

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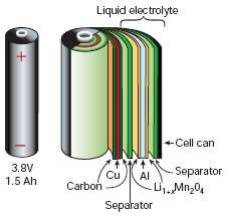
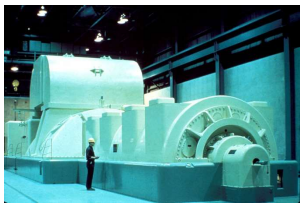
- Electricity
  - Charge Separation
    - Batteries
    - Generators
    - Light
    - Heat



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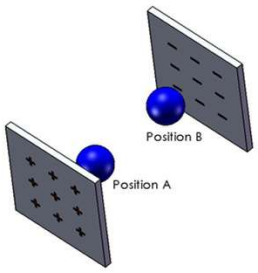
- Electricity
  - Potential Difference
    - The force required to move a charged particle in the presence of an electrostatic field




*Electric potential energy is the amount of work required to move a charged particle from position B to position A.*

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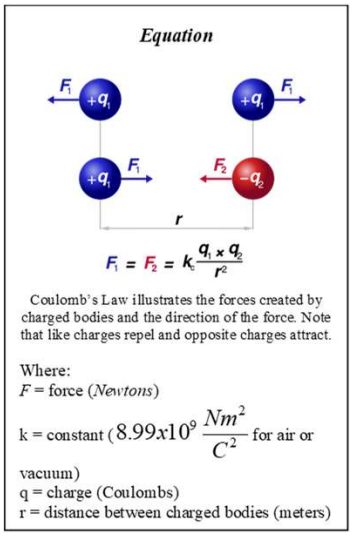
- Electricity
  - Electrostatic Fields
    - Forces resulting from the accumulation of stationary electrical charges
    - Like charges repel, opposite charges attract
  - Coulomb's Law
    - Describes the forces between charged particles
  - Coulomb Charge = 6.25 x $10^{18}$ electrons

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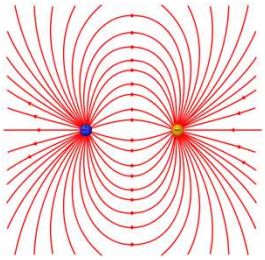
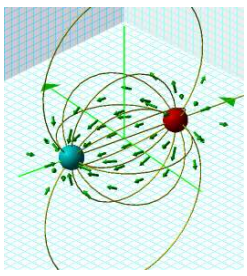
- Electricity
  - Lines of Force
    - Indicate both direction and magnitude
    - Point from positive to negative
    - Line density near charged particles reflect increased field strength
  - Electrostatic Field Applications
    - Parallel plate capacitors, xerographic copy machines, laser printers, and inkjet printers





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- Electricity
  - Circuit Elements
    - ***Source*** – separates charge; provides potential difference to electrons
    - ***Load*** – device performing useful work
    - ***Conductors*** – provides a low resistance path for electron flow
    - ***Control*** – a device used to control electron flow through the circuit.

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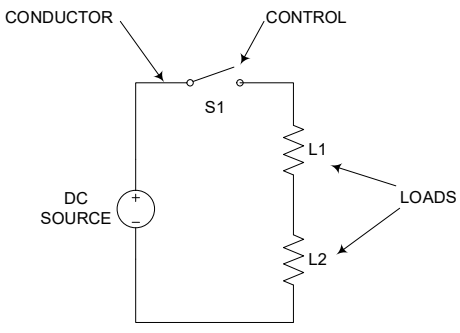
- Electricity
  - Circuit Elements Schematic Diagram

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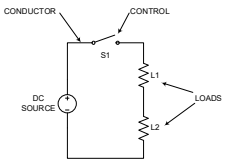
- Electricity
  - Circuit Schematic Diagram
    - A graphical shorthand representation of circuit elements
      - Source, Load, Conductors, Controls
      - Not to scale
    - Simplifies circuit design & interpretation
    - Uses standard symbols for common circuit elements

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**MECH 10**
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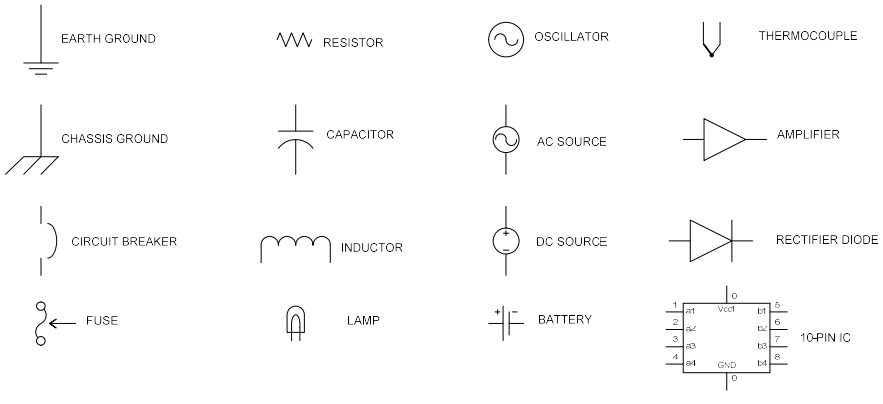
- Electricity
  - Circuit Schematic Diagram
    - Standard symbols for common elements

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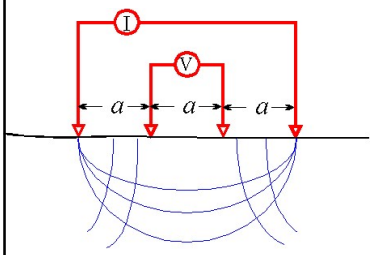
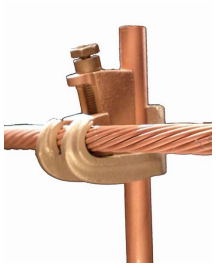
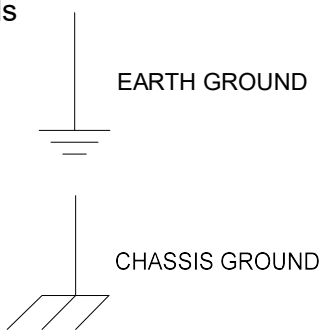
- Electricity
  - Ground
    - ***Idealized*** – an infinite electron sink or source
    - ***Practical*** – a reasonably constant reference for the measurement of other potentials
      - Ground Grids



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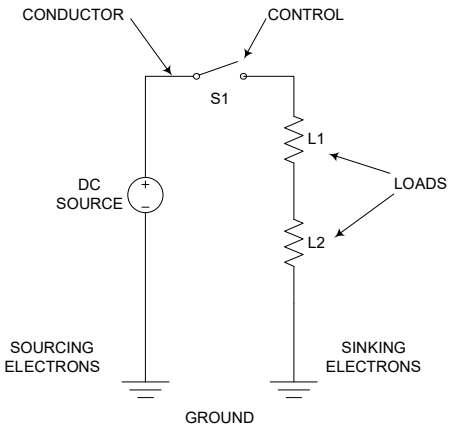
- Electricity
  - Grounded Circuits

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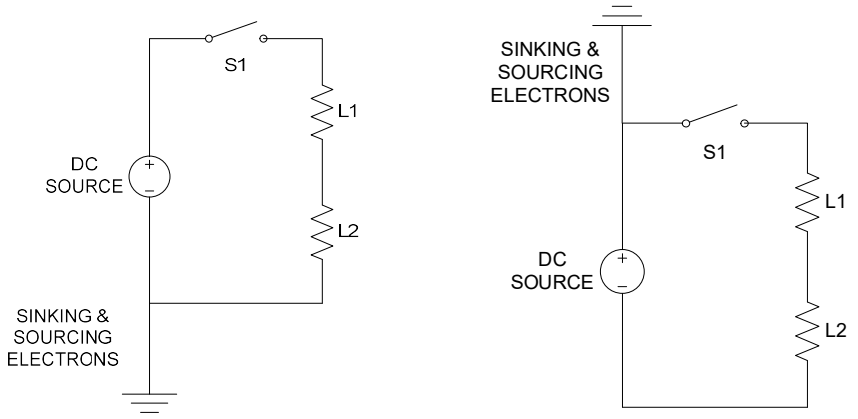
- Electricity
  - Grounded Circuits

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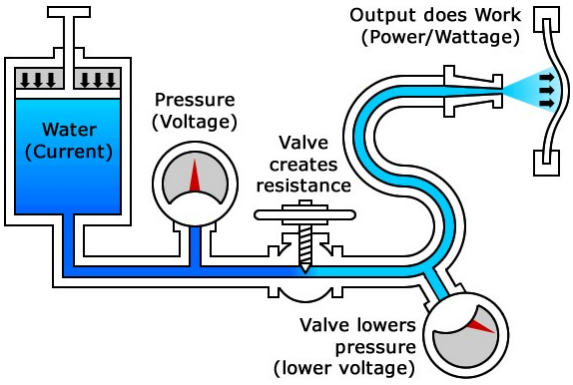
- Electricity
  - The Hydraulic Analogy

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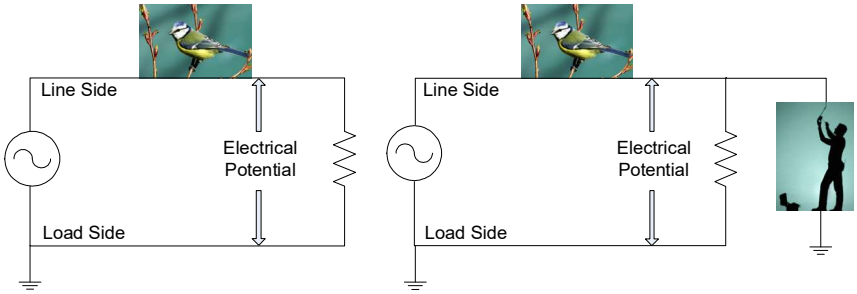
- **Electrical Safety**
  - Shock Current Path – between points of different electrical potential

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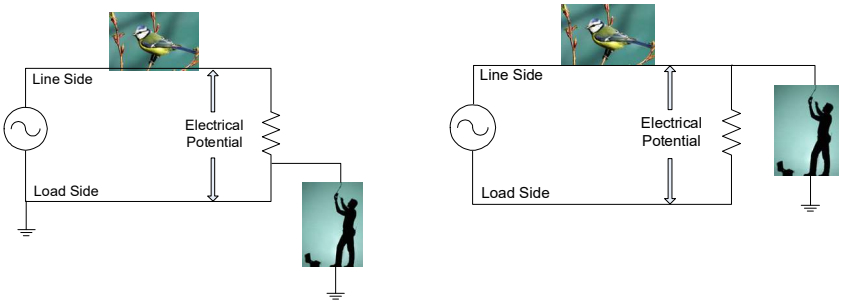
- **Electrical Safety**
  - Shock Current Path – between points of different electrical potential

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- **Electrical Safety**
  - Shock Current Path – between points of different electrical potential
  - NO CONTACT – with bare conductors connected to an electrical circuit, whether energized, de-energized, line side, load side, or floating ground. ALWAYS assume the conductor is hot!

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- Lab 02 – AC Shock Current Path
- **Learning Objectives**
  - Build a simple electrical circuit to demonstrate shock current paths
  - Test the electrical circuit to identify potential shock current paths
  - Calculate shock currents encountered in typical industrial facilities

| | | Points Possible |
|---|---|---|
| **Documentation** | Quality of documentation (neatness, clarity, spelling, complete sentences) | **10** |
| | Safety inspection completed | **10** |
| | Shock currents calculated, documented and accurate | **10** |
| | Physical reactions recorded and accurate | **10** |
| | **Total** | **40** |

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