Overview

• DC generators general theory
  o Permanent magnet
  o Stator, stator windings
• Hand generators experiments
• Interaction of stator and rotor
  o Rotating magnetic field
• READ CHAPTER 12
  o Sections 1 and 2 (section 4 later)
  o Induction motors – their speed; and ‘slip’
Stator and Rotor

(a) (b)

DC Generator

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Hand Generators

- Connect to Fluke handheld meter(s)
  - Measure generated power
  - (Use current clamps?)
  - Exchange red/black +/- polarity… what happens to the values you measure or record?
- Connect to lightbulbs, to just wire, to …?
  - Can you feel any heat being produced?
  - Swap the polarity of your connections and observe any differences.

Hand Generators

- Connect two hand generators to each other.
  1) One person hold grip and handle of Gen “A” with other person holding only the grip (not the crank handle) of Gen “B.”
  2) Person one – generate away
  3) What happens at ‘generator’ 2?
  4) Generate the opposite direction.
  5) Swap polarity of connections.
  6) Count the number of rotations at “A” and at “B”
    - Are they different? Why?

Hand Generators

- What are all the types of energy being converted – from what and to what – as you use these generators?

Magnetic Field Experiments
Calculations: Faraday & Lorentz

\[ e = Bl \Delta v \]

\[ F = Bli \]

- \( e \): Voltage across a conductor
- \( B \): Flux density seen by the conductor
- \( l \): Length of the conductor
- \( \Delta v \): Relative velocity of the conductor \( \text{wrt} \) the magnetic field
- \( F \): Force exerted on conductor
- \( i \): Current through conductor

Linear Motion

- The interaction between the magnetic field \( B \) and the current generates a force

\[ F = Bli \]

Force direction on a current-carrying conductor placed in a magnetic field \( B \) (current into the page).

Lorentz Force & Electric Machines

We inject current, and in response a force is exerted on our conductor.

Here, we force the motion of the conductor, and in response a current is 'induced' – Yay! We have generated electrical energy!

Introduction to Stator & Rotor

Stator

Rotor

Windings
Rotating Fields and Equipment

Summary

- DC generators
- Electric and magnetic fields in motion
  - Rotating fields
  - Inducing (creating) each other
- Faraday and Lorentz
- Prepare for next week!
  - Read chapter 12, in Moodle