Electric Potential, Electrical Potential Energy, And Intro to Capacitors
Chapter 20

I. Norten's notes: *Here, we shift to the idea of electric potential, more commonly referred to as "**potential**" or "**voltage**". Another HUGE concept here is the energies associated with charges and electric fields. This energy is called "**electric potential energy**". Be very careful here—keep straight in your mind the difference between "electric potential" and "electric potential energy". THEY ARE VERY RELATED, BUT VERY DIFFERENT THINGS!*

II. Student objectives: *Students will be able to . . . .*

A. Understand the concept of electric field so they can:
   1. Define it in terms of the force on a test charge.
   2. Calculate the magnitude and direction of the force on a positive or negative charge placed in a specified field.
   3. Given a diagram on which an electric field is represented by flux lines:
      a. Determine the direction of the field at a given point.
      b. Identify locations where the field is strong and where it is weak.
      c. Identify where positive or negative charges must be present.
   4. Analyze the motion of a particle of specified charge and mass in a uniform electric field.

B. Understand the concept of electric potential so they can:
   1. Calculate the electrical work done on a positive or negative charge that moves through a specified potential difference.
   2. Given a sketch of equipotentials for a charge configuration, determine the direction and approximate magnitude of the electric field at various positions.
   3. Apply conservation of energy to determine the speed of a charged particle that has been accelerated through a specified potential difference.
   4. Calculate the potential difference between two points in a uniform electric field, and state which point is at the higher potential.

C. Know the potential function for a point charge so they can determine the electric potential in the vicinity of one or more point charge.

D. Understand the nature of electric fields in and around conductors so they can:
   1. Describe the electric field of parallel charged plates.
   2. Explain why no electric field exists inside a conductor.
   3. Explain why all excess charge must reside on the surface of a conductor.
   4. Explain why a conductor must be an equipotential. Apply this principle in analyzing what happens when conductors are connected by wires.
   5. Determine the direction of the force on a charged particle brought near an uncharged or grounded conductor.
   6. Describe and sketch a graph of the electric field and potential inside and outside a conducting sphere.

E. Understand induced charge and polarization in order to describe charging by induction.
F. Understand energy storage in a capacitor in order to:
    1. Relate voltage (electric potential), charge, and stored energy for a capacitor.
    2. Recognize situations in which energy stored in a capacitor is converted to other forms of energy.
G. Understand the Physics of parallel-plate capacitors so they can:
    1. Describe the electric field inside the capacitor, and relate the strength of the field to the potential difference between the plates and the plate separation.
    2. Determine how changes in dimension will affect the value of the capacitance.

III. Activities:

A. **Read Chapter 20**
B. Demonstrations: Van de Graaff
C. Electric field lecture
    1. Definition (magnitude, direction)
    2. Examples....including equipotentials
    3. Video clips
        1. Agrotors
        2. Tango & Cash
D. Lab, Mapping the Electric Field

E. **Problem set #1, Ch 20: Electric Potential basics**

P (try these first)	1, 3, 4, 8, 9, 10, 12, 22, 23, 24
CQ	1, 3, 5, 7, 8
CE	1, 2, 3, 5, 14

F. Electrical energy lecture with sample problems

G. **Problem set #2, Ch 20: Electric potential energy**

P	16, 17, 19, 20a

H. **Problem set #3, Ch 20: Capacitors**

CE	15, 18
P	40, 41, 42, 46, 54, 56