Exam will cover from sections 15.1 to 17.7 in book
• Will not cover sections 15.7, 17.7, 17.8
• Exam will take place Wednesday from 8:20 – 10:10 pm
• Arrive by 8 pm to get settled in
• Bring calculator, #2 pencils, UF ID and one 8½” x 11” handwritten formula sheet
• Needed constants will be provided to you on the exam
• Room assignments:
  • Last name A-G: CLB C130
  • Last name H-P: MCCC 100
  • Last name Q-Z: WEIM 1064

Chapter 15: Electric Forces and Electric Fields

Electric Fields:
- Electric charges, charge quantization
- Conductors and insulators
  - Qualitative behavior; charging by conduction (contact) and induction
- Coulomb’s Law
  \[ F = \frac{k|q_1 q_2|}{r^2} \]
  - Force is attractive for oppositely signed charges, repulsive for like signed charges

Electric Flux and Gauss’s Law
- Electric Flux, \( \Phi_E \), is defined as
  \[ \Phi_E = E A \cos \theta \]
- Gauss’ Law
  \[ \Phi_E = \frac{Q_{\text{inside}}}{\epsilon_0} \]
  - Use Gaussian surfaces to compute \( E \)
- Electric field of a non-conducting sheet:
  \[ E = \frac{\sigma}{\epsilon_0} \]
- Electric field of a conducting sheet:
  \[ E = \frac{\sigma}{2\epsilon_0} \]
Electrostatic force is conservative \(\Rightarrow\) electric potential energy

Work, potential energy in uniform E:

\[
W = q E_x \Delta x; \quad \Delta \text{PE} = -W = -q E_x \Delta x
\]

Electrical potential

\[
\Delta V = V_x - V_y = \frac{\Delta \Phi}{q}
\]

- Potential and potential energy are not the same!
- Units: 1 Volt = 1 J/C

PE gain/loss of moving charges in potentials
- Work-energy theorem applies!

Electrostatic force for point charges:

Scalar (algebraic) superposition; easier than fields!

Potential energy of a point charge in a potential:

\[
PE = q \Delta V = k \frac{q_Q}{r}
\]

The signs of the q’s matter
- For same sign charges, PE > 0
- For charges of opposite signs, PE < 0

Electron volts: 1 eV = 1.6 x 10^{-19} J

Equipotential surfaces

Capacitance:

\[
C = \frac{Q}{\Delta V}
\]

- Units: 1 Farad = 1 C/V

Capacitance of parallel plate conductor

\[
C = \varepsilon_0 \frac{A}{d}
\]

Circuits and circuit diagrams

Capacitors in parallel
- Each cap. has same \(\Delta V\)

\[
C_{eq} = C_1 + C_2
\]

Capacitors in series
- Each cap. has same Q

\[
\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}
\]
Chapter 16: Electric Energy and Capacitance

- Handling capacitor problems:
  - Every complex circuit can be reduced step-by-step to a simpler circuit using equivalent capacitances.
  - Redraw the circuit after every reduction!
- Remember that capacitors in parallel have the same voltage and capacitors in series have the same charge.
- Don’t be fooled by complex looking circuits; they can all be reduced to a circuit with a single capacitor!
- To find the charge or voltage on an individual capacitor in a complex circuit, you have to reduce the circuit to a simple capacitor to find some quantity and then work your way back to the individual capacitor.

Energy stored in a capacitor = \( \frac{1}{2} Q \Delta V \)

Write as:

\[
E = \frac{1}{2} Q \Delta V = \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} C \Delta V
\]

Capacitors with dielectrics:

\[
C = \kappa C_0 = \kappa \varepsilon_0 \frac{A}{d}
\]

- \( \kappa \) is the dielectric constant of the material in between the plates.

Chapter 17: Current and Resistance

- Current – rate that charge flows through a surface:
  - Units: 1 A = 1 C/s
  - Current direction: defined in the direction that positive charge flows.
- Precise definition of circuit - a closed path of some sort around which current circulates.

Resistance in a circuit:

\[
R = \frac{\Delta V}{I}
\]

- Units: 1 \( \Omega \) = 1 V / A
- Rearrange to get Ohm’s Law:
  - Linear relation between \( I \) and \( \Delta V \):
  - \( \Delta V = IR \)
- Resistivity \( \rho \):
  - Intrinsic to material
  - Resistance depends on geometry and intrinsic material.
Chapter 17: Current and Resistance

- Temperature dependence of resistivity: \( \rho = \rho_0 [1 + \alpha(T - T_0)] \)
- Of resistance: \( R = R_0 [1 + \alpha(T - T_0)] \)
- Energy in a circuit
  - Battery increases charge energy by \( \Delta Q \Delta V \)
  - Charge energy is dissipated in the circuit

The rate at which the energy is lost is the power

\[ P = \frac{\Delta Q}{\Delta t} = \dot{Q} \]

From Ohm’s Law, alternate forms of power are

\[ P = I^2 R = \frac{\Delta V^2}{R} \]

And finally remember...

- You will still need the physics you learned in PHY2053:
  - Kinematic equations
  - Newton’s laws
  - Conservation of energy
  (wouldn’t be a bad idea to have these equations on your formula sheet ;-) )
- Many physics problems involve trigonometry