Review Notes for chapters 23 - 26

Introduction
These chapters examine the basic properties of the electric field.

I  Basic Laws and Properties you should know and understand.
   1. Definition of $\mathbf{E}$ in terms of Force.
   2. Gauss' Law
   3. Conservative nature of electric field.
   
   ... you should be able to ...
   * draw field lines
   * employ symmetry and superposition
   * derive Coulomb's law
   * parametrize physical integrals for continuous charge distributions
   * discuss electrostatic properties of conductors

II  Potential Difference is the most important derived quantity. You should ...
   1. Know the definition in terms of work
   2. Know the line integral expression
   3. Know the expression in terms of point-charge contributions
   4. Be able to draw equipotential surfaces from field lines
   5. Graph $V$ in simple situations and know how to shift the reference point.

III Capacitance
   1. Know the definition
   2. Know how, in principle, you would compute it for some configuration.
   3. Know the expression for the energy stored (and how to derive it).
**Review Notes for chapters 29 - 31**

**Introduction**
The central content of these chapters is the relation between magnetic field and current (i.e. any charge in motion). The ideas fall into two distinct groups. First, the Lorentz law / Ampere's law group describes just how the magnetic field exerts a force on any moving charge...and the flip side...how any moving charge creates a magnetic field. Second, the Faraday's law / Lenz' law group describes what happens when the magnetic field itself is changing with time...namely that an Emf will be observed around any loop through which the magnetic flux is changing.

**Ia  Lorentz Force Law** describes just what force a moving charge will experience.

* You Should Know ...
  * form for a moving point charge,
  * form for force on a segment of current-bearing wire.

* Necessary Technical Tools...
  * familiarity with cross-product and right - hand rule.

* Typical Problems to Know About (derive! don't memorize)...
  * circular motion of a point charge in a uniform B-field.
  * force on a straight length of wire in a uniform B-field.

**Ib  Ampere's Law** describes what magnetic field you get from a given current.

* Necessary Technical Tools...
  * meaning of circulation and threading current
  * choosing Amperian loops to utilize symmetry
  * conventions on orientations of loops and surfaces.

* Typical Problems to Know About (Derive! don't memorize)...
  * straight wire bearing a constant current
  * sheet of current
  * solenoid and toroid.
IIa  **Faraday's Law** describes the Emf generated by a changing magnetic flux.

*Necessary Technical Tools*...
* meaning of "flux"
* meaning and use of concept "Emf"

*Typical Problems*...
* problem set 10

IIb  **Lenz' law** describes the directions of generated Emfs and forces. This law is really contained in Faraday's law if you use the sign conventions fully (and not just magnitudes). Most people tend to remember Lenz' law separately.

*General Skills* ...
* parametrization of physical integrals
* exploiting symmetry
* checking dimensions
* superposition (wherever possible)
* \( \vec{F} = m\vec{a} \)

**Review Notes on Circuits: chapters 27, 28, 32, 33**

You Should Be Able to ...

* Use Kirchhoff's laws to generate the equations which enable us to find the current.
* Transfer voltage equations to energy equations via *Power* ...
* set up and discuss RC, RL, LC, RLC circuits qualitatively
* Discuss the meaning of the quality factor “Q” in both driven and undriven LRC circuits.
General Skills ...

* **Dimensions**  Express the dimension of each of the following in terms of the four basic ones:

{ E, B, R, C, L, J, V, \(\varepsilon_0\), \(\mu_0\), \(\Phi\) both E and B}

* **Parametrization of Integrals**

* **Uncertainty Analysis**