EE243 Advanced Electromagnetic Theory

Lec #2: Electrostatics (to Poisson Eq.)

- **Electric field defined as force per unit charge**
- **Formula: radial outward and inverse sq. distance**
- **Gauss Law**
- **Scalar Potential and Work Done on Charge**
- **Poisson's Equation**

Reading: Jackson
1.1-1.7

Electric field = Force /q

- List of Characteristics
  - radial outward and inverse sq. distance, etc
- Formula E(**x**) for charge at **x'**
- Extension to multiple charges and distributions

Properties of Delta Functions

Described on pp. 26

- Simple delta
- Derivative of delta => - derivative of function
- F(x) argument => sum of zeros inversely weighted by slope of function at the zero
- Vector argument => product of delta for each component

Gauss Law

- Interpret product of E times normal as solid angle
- Integration over a closed surface gives factor of 4π
- Differential form from Divergence Theorem

Scalar Potential

- Note that form of E field is Grad inverse distance
- Take grad outside integral
- View integral as potnetial and E = - Grad

- Physical interpretation of potential as work done on charge
- Work in moving charge around loop is zero => Curl **E** = 0

Surface Distributions of Sources

Surface Charge

- Div **D** = σ/ε_0 => **D** normal discontinuous by σ/ε_0

Dipole Layer

- Dipole moment $\underline{D}$ is product of + and - charge divided by distance directed normal toward positive charge
- To treat singularity use Taylor Series in d (derivative term is like **E** and gives solid angle integral)
- Potential is discontinuous by $\underline{D}/\varepsilon_0$