

Electrostatics – Magnetostatics L1

I Introduction and concepts

- 1) Electrostatics devices**
- 2) Electric charges**
 - a. Punctual charges
 - b. Continuous charges distributions
- 3) Electric forces and Electric fields**
 - a. The Coulomb law
 - b. The electric field
 - c. Field lines
- 4) Electric potential and energy**
 - a. Work of an electric force
 - b. Electric potential
 - c. Equipotential lines
- 5) Electric field created by superposition of charges**
 - a. Two electric charges: Shape of the field lines
 - b. N electric charges
 - c. Continuous charges distribution
- 6) Symmetries of the electric field**

II Examples of electric field calculations

- 1) Electric field created by a charged electric wire**
 - a. Calculation of the electric field
 - b. Calculation of the electric potential
 - c. Limit case of the infinite wire.
 - d. Analysis in terms of field lines
- 2) Some examples of 2D electric charged structures**
 - a. Electric field and electric potential created by a crown and a disc
 - b. Limit case of the infinite charged plane
 - c. Analysis in terms of field lines
- 3) Application to the plane capacitor**
 - a. Electric field and electric potential
 - b. Capacitance and energy.
 - c. Electron dynamics in a constant and uniform electric field

III Gauss theorem

- 1) Need of Geometry**
 - a. Notion of vector flux
 - b. Solid Angle
- 2) Statement of Gauss theorem**
- 3) Direct applications**
 - a. Electric field created by an infinite wire
 - b. Electric field created by an infinite plane
- 4) Electric field calculations**

- a. Empty and full charged cylinder
- b. Empty and full sphere

4) Cylindrical Capacitors

5) Earth as a Capacitor

IV Some Applications

1) Electrostatic dipole

- a- Potential and electric fields in the dipolar approximation
- b- Molecules
- c- Dipole-dipole interactions

2) Electrostatics of conductors

3) High Voltage breakdown

4) Electricity in the atmosphere (from Feynman lecture)