electricity lecture notes

erentar

2023-02-17 - present

Contents

Chapter 0

Nomenclature and conventions

Definitions are ended with a □

Chapter 1

Intro

1.1 Books

- Giancoli physics: electricity, magnetism, optics, and modern physics (he thinks this is bad because no exercises, but provides of an easy reading)
- Fundamentals of electric circuits, Alexander, Sadiku

1.2 Exam

3 questions:

1. exercise (solving with thevenin)
2. electrostatics (theory and/or practice)
3. electromagnetism (theory and/or practice)

questions 2 and 3: - theoretical topic (explain/prove the following, derive, ...) - sample problems from lectures - completely new problem

Chapter 2

Electrostatics

Definition 1. *Electrostatics: Study of electrical charges at rest*

□

Coulomb (C): unit of charge.

- Conductors have *free electrons*. Electrons can move through the material.
- Insulators do not have free electrons. Electrons cannot move through the material, they are stronly bound to one atom.
- Semiconductors: are inbetween the other two. They can be tuned such that they only conduct on a conditional basis.

Definition 2. *Coulomb's law: The force $\vec{F}$ between two particles with respective charges $q_1, q_2 2$ are given by*

$$F_{1,2} = \frac{1}{4 * \pi * \epsilon_0} \frac{q_1 * q_2}{r^2} * \underbrace{\vec{e_r}}_{\text{the unit vector of line between the two particles}}$$

where

- q_1, q_2 are the charges of respective particles
- ε_0 is the permittivity of vacuum

□

2.1 Electric field

Definition 3. *Electric field $\vec{E}$: force per unit charge at a given point*

The force $\vec{F}$ on a charge q within an electric field $\vec{E}$: $\vec{F} = q * \vec{E} \Leftrightarrow \vec{E} = \frac{\vec{F}}{q}$

Electric field is a vector field. It maps a given point to a vector.
`field : point -> vector`

Total electric field $\vec{E}_{\text{total}}$ resulting from two point charges q_1, q_2 at a point P is equal to the sum of these electric fields:

$$\vec{E}_{\text{total}}(P) = \vec{E}_1(P) + \vec{E}_2(P) \tag{2.1}$$

Slide 12 at https://p.cygnus.cc.kuleuven.be/bbcswebdav/pid-34057619-dt-content-rid-329740934_3/orgs/C7964141-B-2223/H01S_Electric%20field.pdf shows the electric field resulting from a charged line. We pretend the line is composed of point charges and integrate from -y to +y to calculate the total charge resulting from the entire line.

To keep the integral as a single-var integral, we fix x to be constant and integrate over the angle θ.