

ECE 30
Day 19

Elijah Hantman

Agenda

- Review Quiz 3
- Finish Modulation of Radio Waves
- Structure of The Atom

Quiz 3 Review

1. I think I messed up cause I'm silly Was supposed to divide 0.5 by 2, and get 0.25
2. I don't remember what I answered. Odds are I got this one wrong, cause I know I missed 3.
3. This one I think I got correct. It really should specify better the direction of current.
4. I definitely got this one correct. I remember my answers.
5. I got this one correct. I understood the orthogonality part of magnetic fields.
6. XD this one I definitely answered correctly It was such a red herring style question
7. I got this one wrong I think. I must have forgotten to flip the direction for the current. Idk The professor was getting messed up, we definitely need diagrams for this XD.
8. I definitely messed this one up cause I remember the answer I gave. It rotates in the magnetic field.
9. This was directly from lecture super easy
10. Both fields. I got this one, it makes sense since both fields are changing.
11. Easy, straight from the definition of magnetic forces. Definitely got this one correct.

Modulation

Given some modulating signal $m(t)$. We multiply it by $v(t)$ which is much higher frequency.

By multiplying by $v(t)$ we get a signal which is easier to detect.

The Frequency of $RF(v(t))$ signal \gg the frequency of $m(t)$. We can therefore filter out $v(t)$ to leave $m(t)$.

When receiving, we filter the RF, and get back $m(t)$.

For a digital signal $m(t)$ will not be sinusoidal. It will instead be some series of high and low voltages in a fixed time.

The simplest technique is to use Amplitude Shift Keying (ASK). It uses the same multiplicative idea. Essentially we can transform $m(t)$ to be between two non zero amplitudes.

This has the downside of requiring massively high frequencies in order to have enough resolution to separate each bit quickly.

In WIFI, or Satellite Quadrature Amplitude Modulation is used (QAM).

Two signals are used, each a quarter cycle out of phase. By blending between the two signals you can indicate a one or zero.

Frequency Shift Keying

We instead tie two frequencies to a one and a zero, and modulate between them to indicate digital data.

This is more reliable since the amplitude can remain high.

It is used by LTE, and 5G technologies.

Structure of The Atom

Observations by 1890s:

- Atoms contain electrons.
- The charge of electrons is negative and has been directly measured.
- Electrons were super light.
- Atoms are neutral (putting aside chemistry)

In the Early 20th Century the Thompson Model was created (1898). He modeled atoms as a ball of positive charge, with electrons embedded in its surface.

When experimenting Rutherford followed up in 1911 by experimenting with firing α particles at ultra thin gold foil. He then measured how many particles made it through the foil. He saw that some did make it through, but some particles actually bounced back.

Rutherford concluded that the nucleus of the atom must be tiny, and that it must have a powerful electric field. This means Atoms must be mostly empty space.

Rutherford then developed an orbital model based on these conclusions.

As a side note:

An electron volt is voltage multiplied by the charge of an electron. It is equivalent to a Joule in that they measure the same thing, however an Electron volt is nicer for physics since it uses units of electrons.

Assumes that electrons are bodies orbiting and that the centripetal force is equal to the electrostatic force.'