Fields and waves

Jigmagn

	Mid sem	30%.
A at 80%.	End sem	40%.
	Quiz x 6 (N-1)	30%.

pass: 30%.

grading: absolute

attendance in tutorials: atleast 75%. required for attempting next quiz

Office hours:
Wed 12:30 – 1:15 pm

- Vector calc
- Electrostatics and Magnetostatics — doesn't vary with time
- Electrodynamics — varies with time
- EM waves
- Transmission Lines

Book: David J. Griffiths
Intro to Electrodynamics

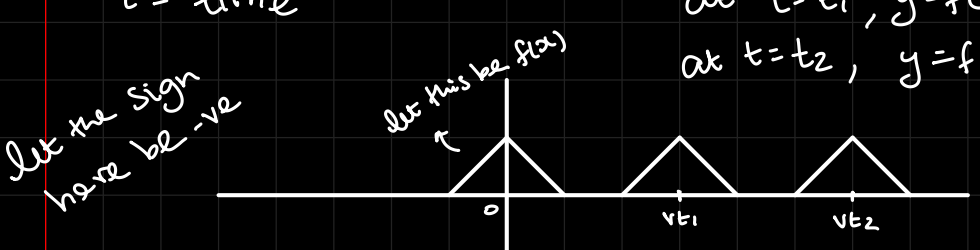
M.N.O. Sadiku
Elements of Electromagnetics

- wave

$$y = f(x \pm vt)$$

v = constant
t = time

at $t = 0$, $y = f(x)$
at $t = t_1$, $y = f(x - vt_1)$
at $t = t_2$, $y = f(x - vt_2)$



forward travelling wave →

if sign = +ve : backward travelling wave ←

$$F_E = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r}$$

$$F_{Grav} = G \frac{m_1 m_2}{r^2}$$

} with unit masses and unit charges kept at 1m distance,

$$\frac{F_E}{F_{Grav}} \simeq \frac{10^{12}}{10^{-11}} = 10^{23}$$

speed of free electron: $\sim 10^5$ m/s

in a conductor: electron takes 1s to move 1mm

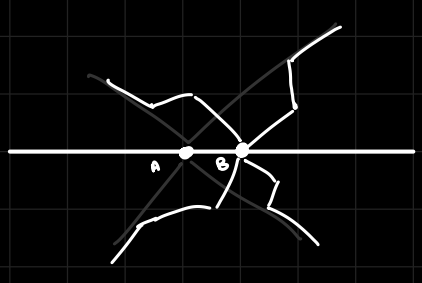
then how does a hall lights up almost instantly when you switch on the light?

because e^- are chained together in nature and the initial e^- doesn't travel all the way from beginning to the end of the hall

CE, FCL: radiation certification

Electric field lines have to always end at a charge: $\oplus \rightarrow \ominus$

When the charge has been moved, the field lines will also have a disturbance



KCL and KVL don't work with very large circuits because of signal propagation delay

direction of E × H → source to load

min time taken for propagation $= \frac{c}{x}$

$c = \lambda f$

wavelength $= \lambda = \frac{c}{f}$

let $f = 50$kHz,

$$\lambda = \frac{3 \times 10^8}{50} = 6 \times 10^6 \text{ m}$$

KCL/KVL applicable when circuit size < wavelength

for $f = 10$GHz $= 10 \times 10^9$Hz

$$\lambda = \frac{c}{f} = 3 \times 10^{-2} \text{ m} = 0.03 \text{ m}$$

for any circuit with length (x) greater than 3cm, KCL and KVL will not apply