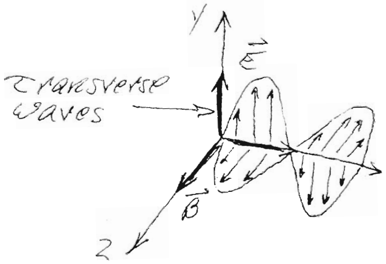
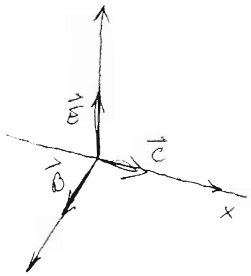
EM Waves





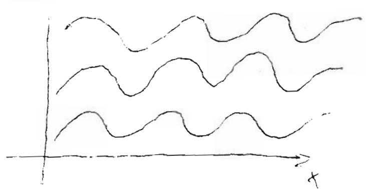
linearly polarized case:
$\vec{E} \parallel \hat{j}$
$\vec{B} \parallel \hat{k}$

$$E = E_{max} \cos(kx - \omega t)$$
$$B = B_{max} \cos(kx - \omega t)$$
(only depend on (x, t))

where $k = 2\pi/\lambda$, $\omega = 2\pi f$ and
$\omega/k = \lambda f = c$.

If the orientation of the wave (e.g. angle between $\vec{E}$ & $\hat{j}$) is constant
- linearly polarized wave

Plane waves
- emitted from any (y, z), propagate in x-direction
- in phase



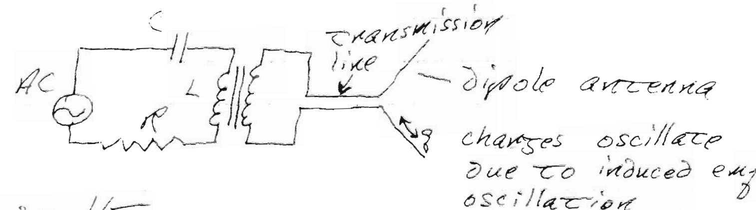
Phase same for all waves at each x ('coherence')

Generating Electromagnetic Waves

Fundamental mechanism

- accelerating charge radiates energy in EM waves
  - can be an oscillating charge

LC oscillator



$\omega = 1/\sqrt{LC}$

For 'EM' → $f \sim 10^8$ Hz or 100 MHz

Electromagnetic Spectrum

Maxwell's Eq's 'predict' speed of EM waves (light), but do not specify λ or ω.

Different names for EM waves, based on λ.

	λ range	
Radio	$> 0.1 m$	LC circuits
μ-wave	$10^{-4} m - 0.1 m$	appliances
infrared	$7\times10^{-7} m - 10^{-4} m$	- room temperature - rotational + vibrational atoms
visible	$4\times10^{-7} m - 7\times10^{-7} m$	- we're most sensitive to yellow
ultraviolet	$6\times10^{-10} m - 4\times10^{-7} m$	- Sun
x-rays	$10^{-12} - 10^{-8} m$	
γ-rays	$< 10^{-10} m$	- nuclear decay