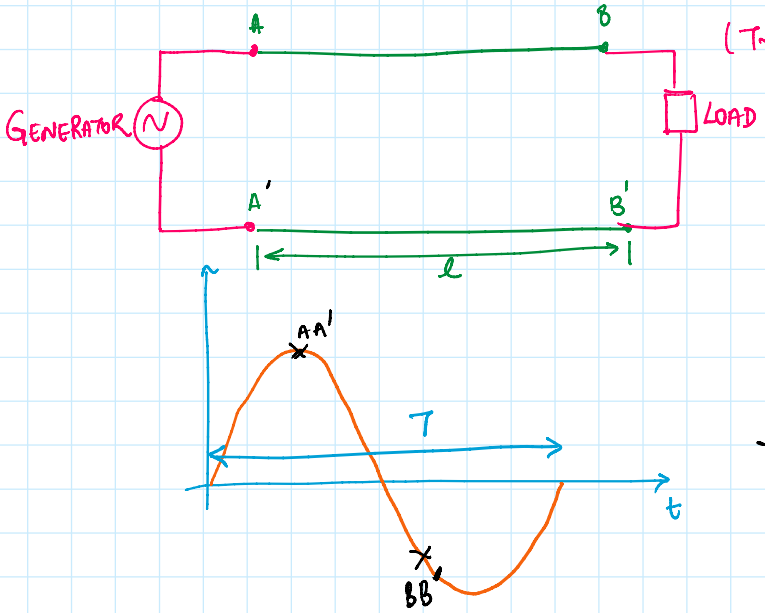
Lec-2

Wednesday, April 1, 2020 8:16 AM

- Thursday office hours - 1:30 - 2:30pm (Regular office hours).
- This week only - Office hours - 12:30pm - 1:30pm (Thursday)

Transit Time Effect



(T_r) Transit time - Time it takes for the signal to propagate from AA' to BB'.

v → Speed with which signal propagates on the transmission line

If the potential at AA' is different than BB' at a given time instant, then consider the pair of wires as a transmission line

Signal time period ← $T >> T_r$ → Ignore the transit time effect

$$T >> \frac{l}{v}$$

$$\frac{1}{f} >> \frac{l}{v}$$

$$\frac{v}{f} = \lambda >> l$$ → Transit time effect can be ignored

(λ: wavelength)

Electrical length of the signal on a medium

- Transit time effect can be ignored if the length of the transmission line is less than 1% of the signal wavelength.

Example: $f = 2\,MHz$, $c = 3 \times 10^8\,m/s$

Q: For which length of the transmission line the transit time effect can be ignored?

time effect can be ignored ?

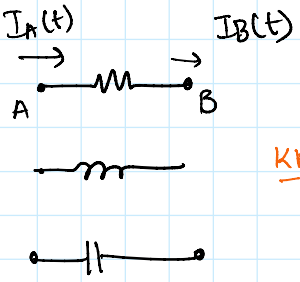
$$\lambda = \frac{3 \times 10^8 \text{ m/s}}{2 \times 10^6}$$

$$\lambda = 150 \text{ m}$$

$\ell < 1.5 \text{ m}$

$f = 10\,GHz$	$\lambda = 3cm$	$\ell < 0.03cm$
$f = 1\,GHz$	$\lambda = 30cm$	$\ell < 0.3cm$
$f = 100\,MHz$	$\lambda = 300cm$	$\ell < 3cm$

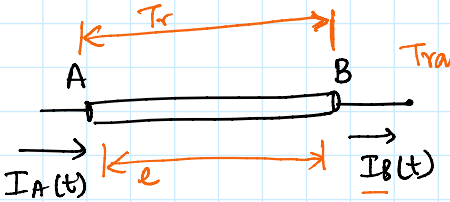
Lumped Circuit



KVL, KCL

$I_A(t) = I_B(t)$ at all time t

Distributed Circuit



Transmission line concepts.

$|I_A(t)| \neq |I_B(t)|$ for all time t.