Phys 1402 2015-10-22 Lec 17

Exam 2 Thu 10/29

AC Voltage pushes AC Current,

$V_{rms} = Z\, I_{rms}$

Z = impedance

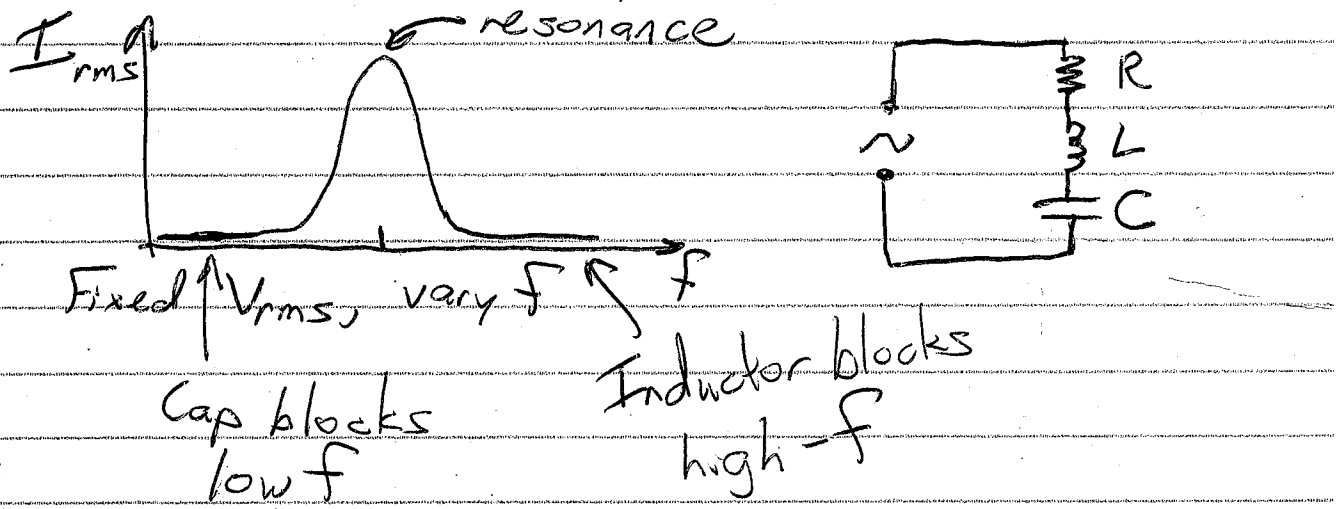
Series Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$X_L = 2\pi f L$ Inductor blocks high-f

$X_C = \frac{1}{2\pi f C}$ Capacitor blocks low-f

Resonant AC Circuit

IF $X_L = X_C$, they exactly cancel



What Frequency is resonant?

$$X_L = X_C$$

$$2\pi f L = \frac{1}{2\pi f C}$$

$$(2\pi f)^2 = \frac{1}{LC}$$

$$2\pi f = \frac{1}{\sqrt{LC}}$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Ex: $C = 0.1\ \mu F$ $\quad f = 93.7\ MHz$

$$(93.7\times10^6) = \frac{1}{2\pi\sqrt{L(0.1\times10^{-6})}}$$

$$2\pi f L = \frac{1}{2\pi f C}$$

$$L = \frac{1}{(2\pi f)^2 C} = \frac{1}{(2\pi(93.7\times10^6))^2(0.1\times10^{-6})}$$

$$= 2.9\times10^{-11}\ H$$

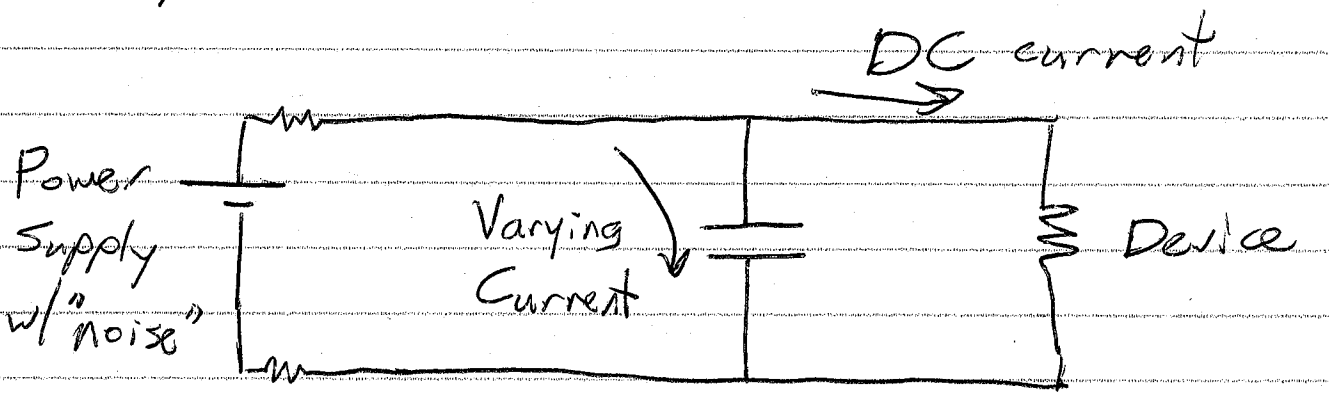
$$= 0.029\ nH$$

$L = \frac{\mu_0 N^2 A}{\ell}$ = tiny for physically small inductor.

What if C is smaller? → L must be bigger.

Filters

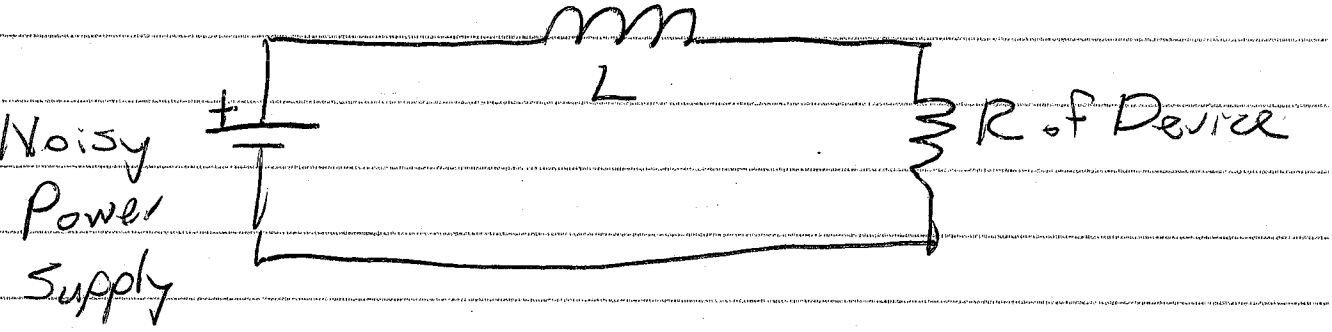
	Low-f	High-f
Inductor	Passes	Blocks
Capacitor	Blocks	Passes



Want V= const.

Any changing V is noise.

Same effect with inductor in series



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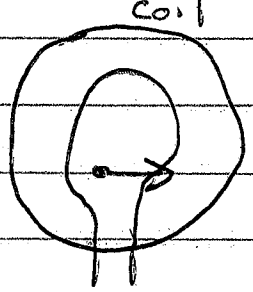


In Lab, an electron beam was directed to the right. The magnetic force made them bend upward. Dir of magnetic field? (Out of page, toward us)

$$F_B = q v_\perp B$$

B points N, proton is dropped. Dir of initial deflection? (East)

In series, a huge Z_i makes Z larger.

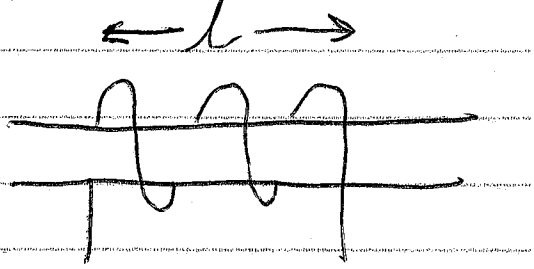
103 K capacitor

$10\,000 \times 10^{-12}\ F = 0.01\ \mu F$

⑤

Wire length 5.73 m
$r = 0.0125$ m
$l = 0.615$ m
} solenoid

$\frac{\Delta I}{\Delta t} = 5.5 \times 10^{2}$ A/s



Loops?

1 loop is how much wire?

$l_{loop} = 2\pi r$

$l_{wire} = N\, 2\pi r$

$(5.23) = N\, 2\pi (0.0125) \rightarrow N = 73$

Inductance?

$A = \pi r^2$

$L = \frac{\mu N^2 A}{l}$ $\qquad L = 5.35 \times 10^{-5}$ H

EMF?

$\mathcal{E} = L \frac{\Delta I}{\Delta t}$ $\qquad \mathcal{E} = 5.35e{-}5 * 5.5e2$

$= 0.029$ V