Alternating Current

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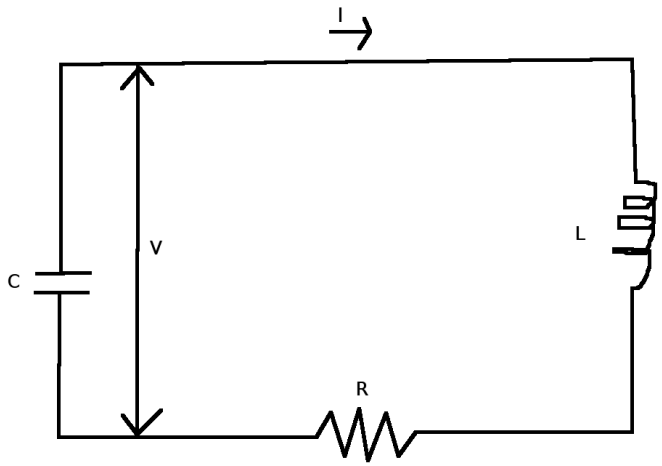
The Series RLC Circuit



Governing equations:

- $I = -\frac{dQ}{dt}$
- $Q = CV$
- $V = L\frac{dI}{dt} + RI$

Write Q and I in terms of V to get

$$\frac{d^2V}{dt^2} + \left(\frac{R}{L}\right)\frac{dV}{dt} + \left(\frac{1}{LC}\right)V = 0$$

That's a Spring

Multiply through by L to get

$$L\frac{d^2V}{dt^2} + R\frac{dV}{dt} + \frac{1}{C}V = 0 \iff m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$$

- L has "intertia" that resists change
- The resisitor provides a drag force
- The capacitor provides a restoring force

$\zeta(r)$ as an Euler Product

$$\zeta(r) = \sum_{n} \frac{1}{n^r} = \prod_{p} \frac{1}{1 - p^{-r}}$$

where p is a prime number

Sit back and enjoy the justification of this. It'll be on Edline this evening.