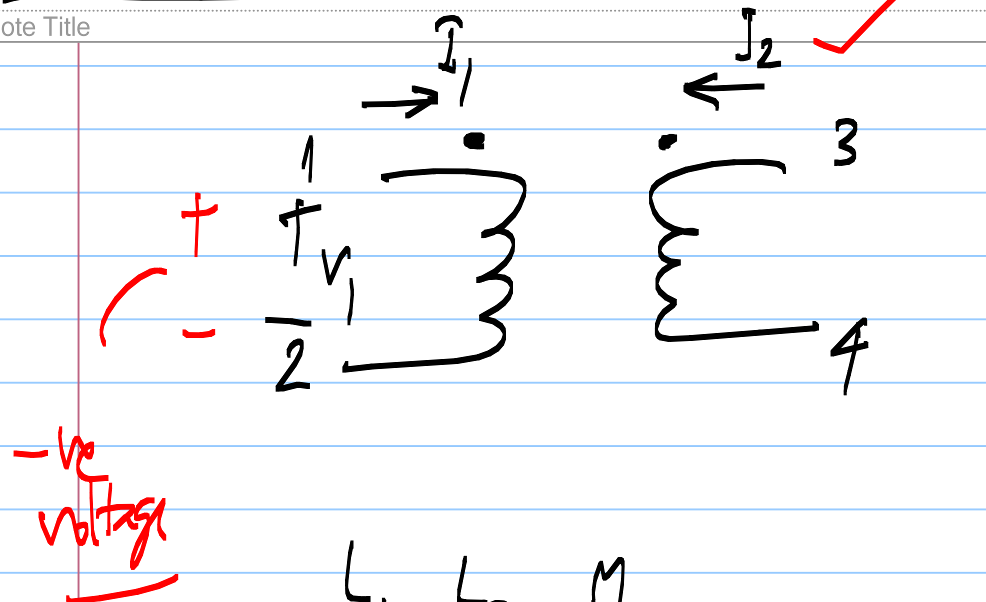
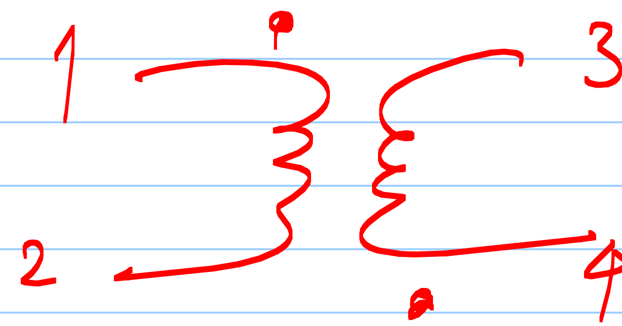
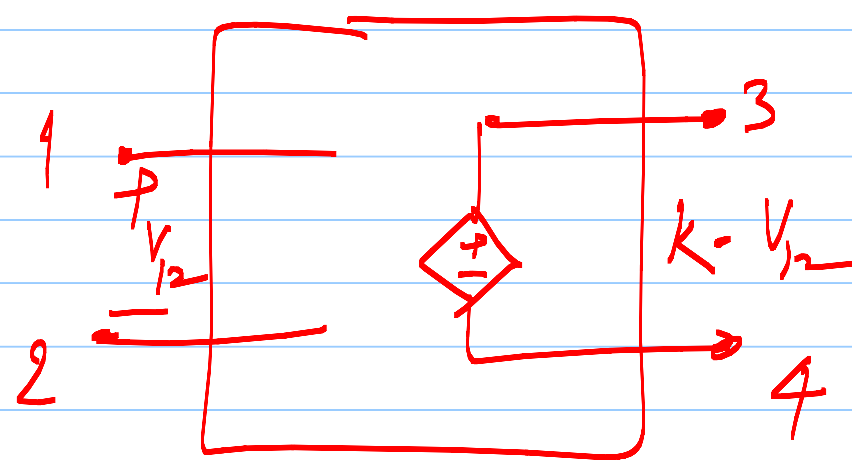
EC1010: Lecture 4

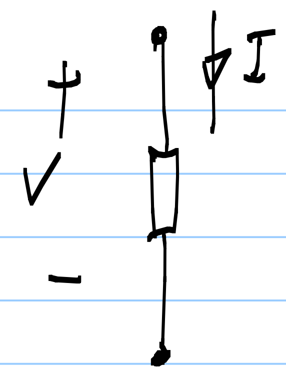
Note Title 1/22/2014



L_1, L_2, M



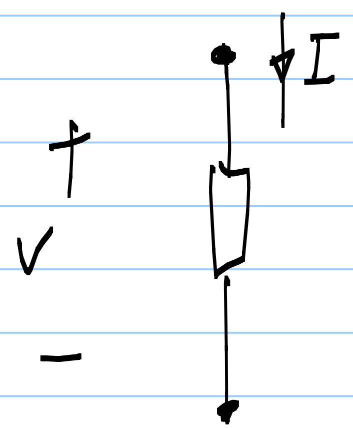




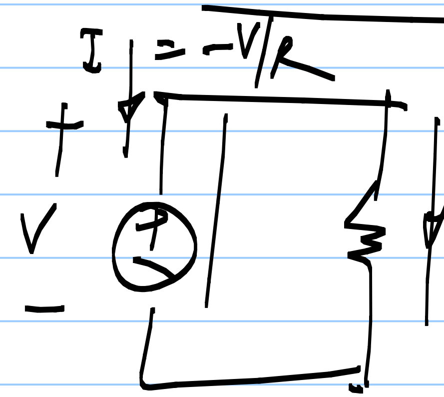
Passive sign convention

Passive elements:

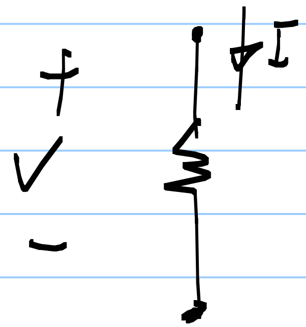
Elements that do not generate power, only dissipate it



$P = V \cdot I$



Resistor:



$I = V/R$

$P = V \cdot I = V^2/R > 0$

Power always dissipated in a resistor

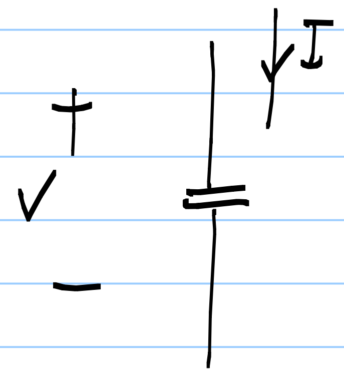
$E = \int_0^{T_0} P(t)\,dt > 0$

Power flowing into the element

Energy flowing into the element

(Energy dissipated)

Capacitor: Can only absorb energy (discharged capacitor)



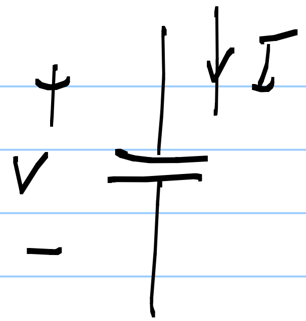
$p(t) = v(t) \cdot i(t)$ Either positive or negative

$$E = \int_0^{T_0} v(t) \cdot C \frac{dv(t)}{dt} \cdot dt \qquad \frac{1}{2}\frac{d}{dt} v^2(t)$$

$$I = C \cdot \frac{dv}{dt}$$

$$= \frac{1}{2} C \left[v^2(T_0) - v^2(0) \right]$$

$v(0) = 0$

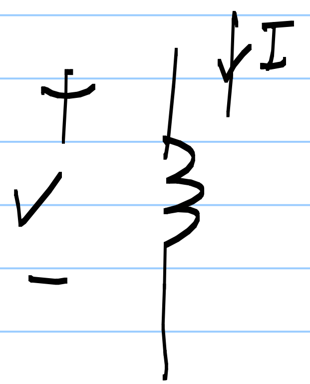


Instantaneous power: positive or negative

Energy : absorbed & stored

Dissipation: Zero

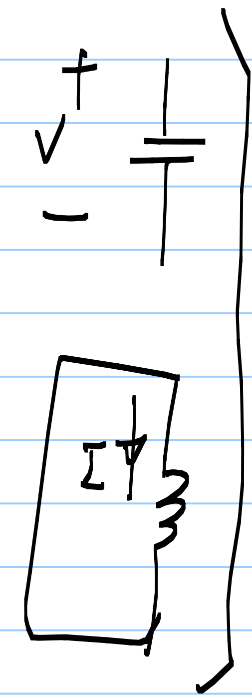
Inductor:



$$P = V \cdot I \quad \text{Either +ve or −ve}$$

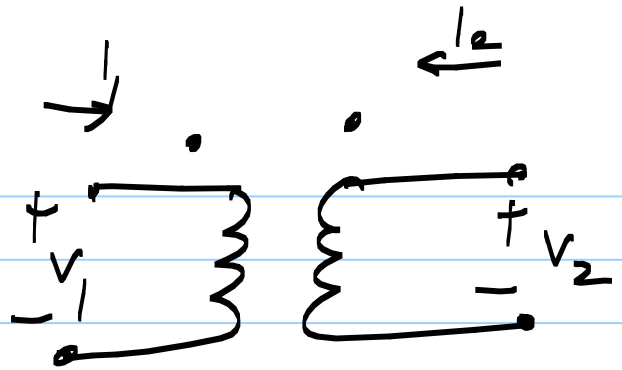
$$E = \int_0^{T_0} L \cdot \frac{dI}{dt} \cdot I \cdot dt$$

$$= \frac{1}{2} L \left(I^2(T_0) - I^2(0) \right)$$



$$V = L \cdot \frac{dI}{dt}$$

$$\text{Stored energy} = \frac{1}{2} L I^2$$



$$P = V_1 I_1 + V_2 I_2$$

$$P = L_1 I_1 \cdot \frac{dI_1}{dt} + L_2 I_2 \frac{dI_2}{dt} + M\left(I_1 \frac{dI_2}{dt} + I_2 \frac{dI_1}{dt}\right)$$

$$V_1 = L_1 \cdot \frac{dI_1}{dt} + M \cdot \frac{dI_2}{dt}$$

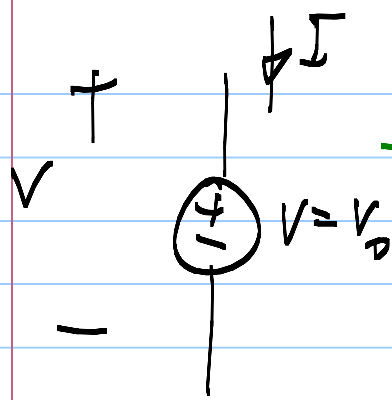
$$V_2 = M \frac{dI_1}{dt} + L_2 \cdot \frac{dI_2}{dt}$$

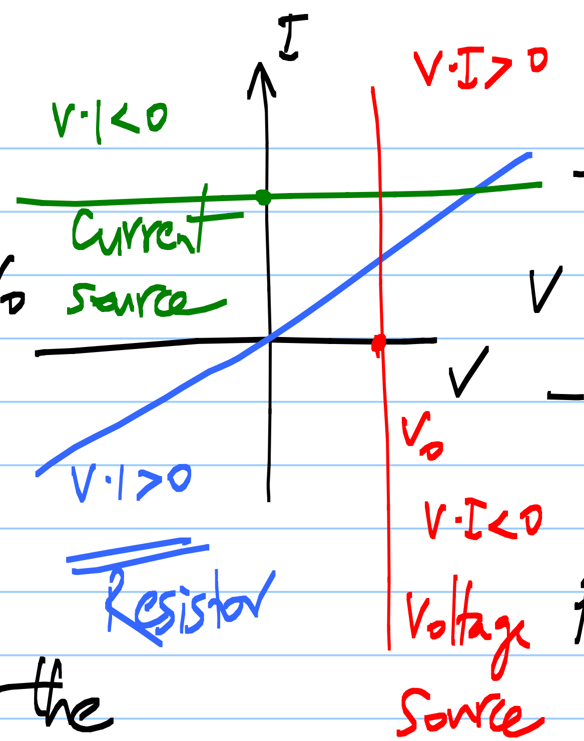
$$E = \frac{1}{2} L_1 I_1^2 + \frac{1}{2} L_2 I_2^2 + M I_1 I_2 \geq 0$$

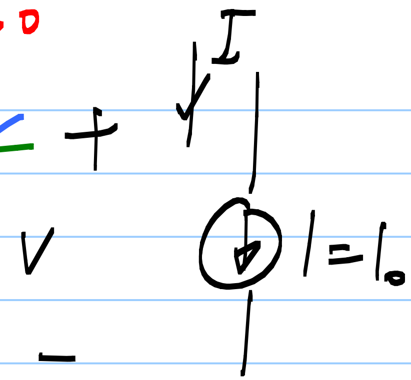
Coupling coefficient

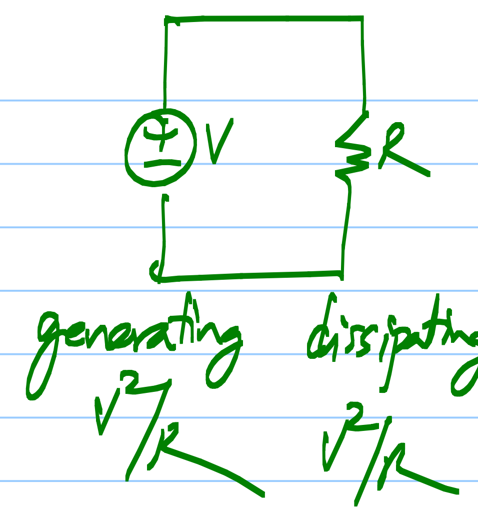
$$k < 1$$

$$M \leq \sqrt{L_1 L_2} \qquad M = k\sqrt{L_1 L_2}$$







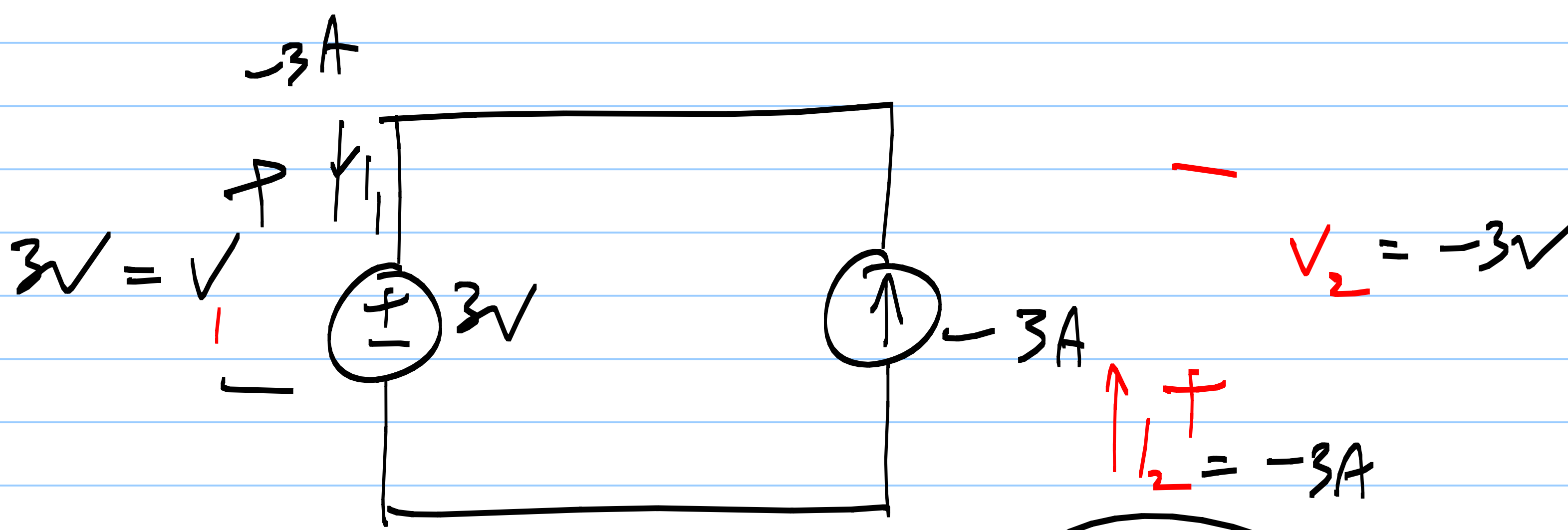


$P = V \cdot I$

dissipated in the voltage source

$P = V \cdot I$

dissipated in the current source



$V_1 I_1 = -9W$

Watt

Joule

$V_2 I_2 = 9W$