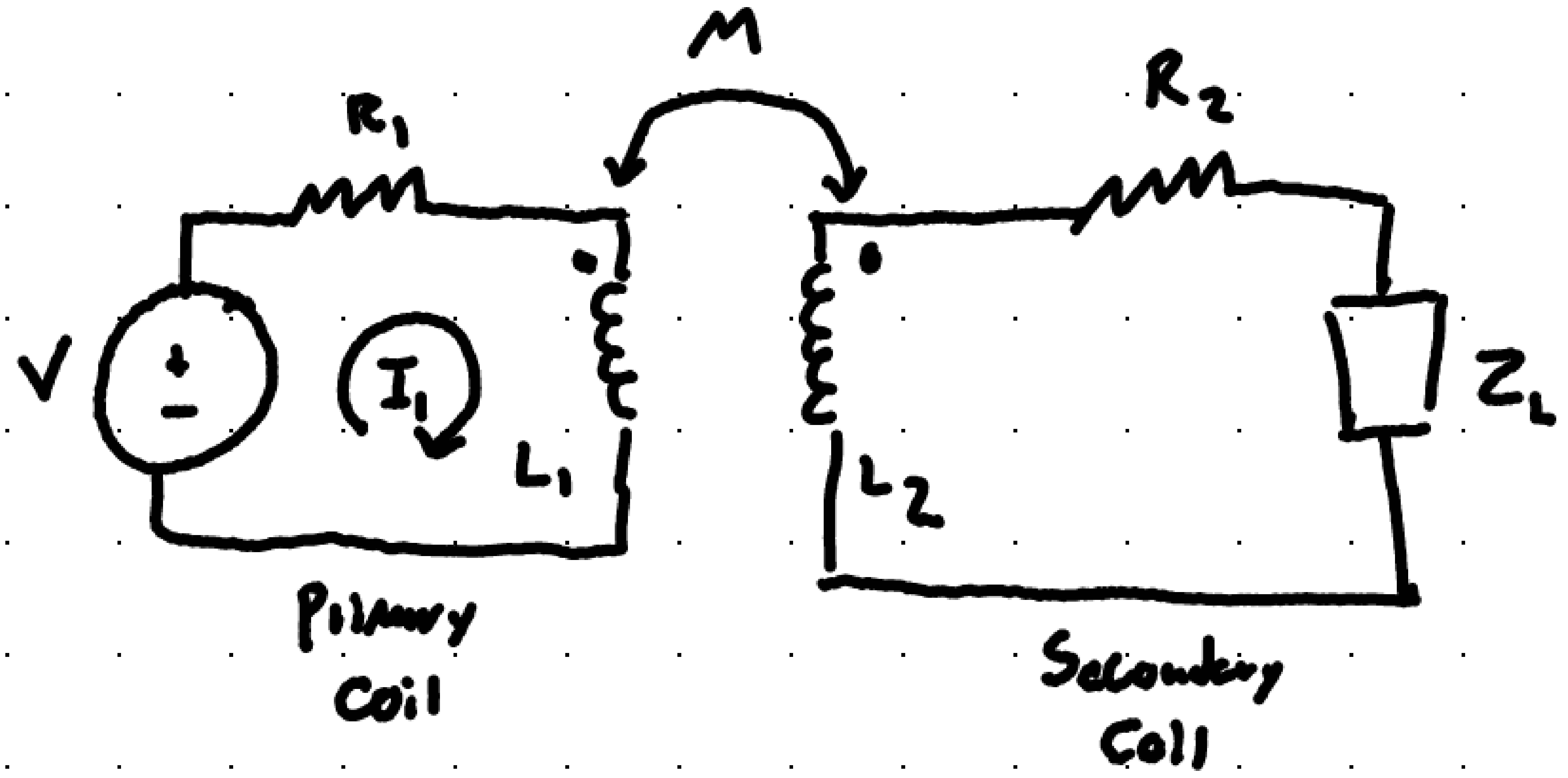
Circuit Analysis : ECED 2001

A Transformer is said to be linear if the coils are wound on a magnetically linear material.

- Such as:
  - Air
  - plastic
  - Bakelite
  - wood
  - Most materials actually

Key Applications

- power Transmission & distribution
- Electrical Isolation
- Voltage Regulation
- power supplies
- Audio systems
- Induction heating and welding



Obtain the input impedance Z_{in} as seen from the Source, because Z_{in} governs the behaviour of the primary circuit

KVL at the primary.

$$V - R_1 I_1 - (j\omega L_1 I_1 - j\omega M I_2) = 0$$

$$V = (R_1 + j\omega L_1) I_1 - j\omega L M I_2 \qquad (1)$$

KVL at the Secondary

$$Z_L I_2 + R_2 I_2 + (j\omega L_2 I_2 - j\omega M I_1) = 0$$

$$(Z_L + R_2 + j\omega L_2) I_2 - j\omega M I_1 = 0 \qquad (2)$$

$$Z = \frac{V}{I}$$

$$Z_R = \frac{\omega^2 M^2}{R_2 + j\omega L_2 + Z_L}$$

Ideal Transformers

An Ideal transformer is one with perfect Coupling ($K=1$)

For reason of power conservation, the energy supplied to the primary must equal the energy absorbed by the Secondary. This is due to the ideal nature having no losses.

This of course implies that:

$$V_1 i_1 = V_2 i_2 \quad \& \quad \frac{I_2}{I_1} = \frac{V_2}{V_1} = n$$

(Turn Ratio)

Turn Ratio:

$n=1$: an isolation transformer

$n>1$: a step up transformer — Increase (V_2 bigger than V_1)

$n<1$: a step down transformer — (V_2 smaller than V_1) Decrease

Rule:

- If both V_1 and V_2 are positive or negative at the dotted terminals, use $+n$. Otherwise, use $-n$.

- If both I_1 and I_2 enter into or both leave the dotted terminals, use $-n$. otherwise, use $+n$

Turn Ratio

$$n = \frac{N_2}{N_1}$$ Number of Turns of 1 and 2