

# BEEE101L – Basic Electrical Engineering

*Source Transformation &  
Introduction to Loop Analysis*

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**Vellore Institute of Technology**

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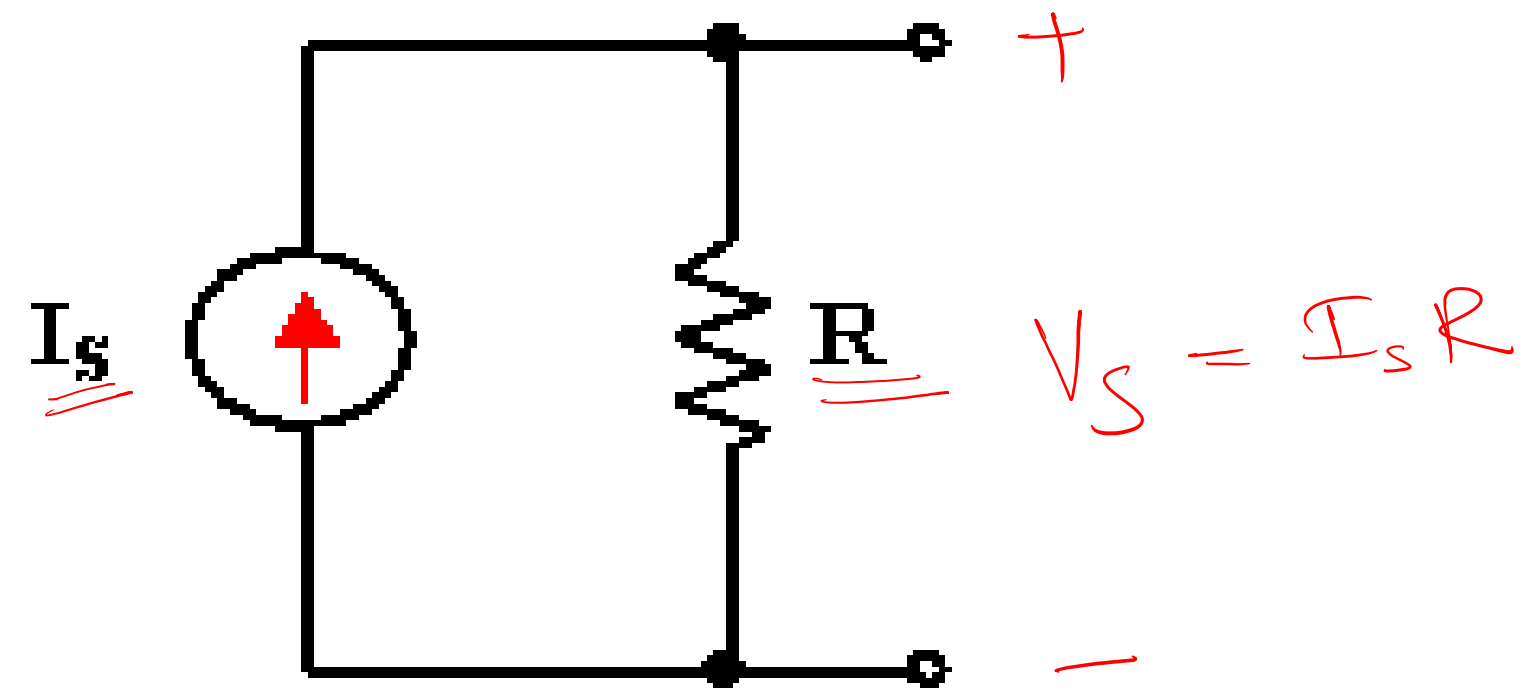
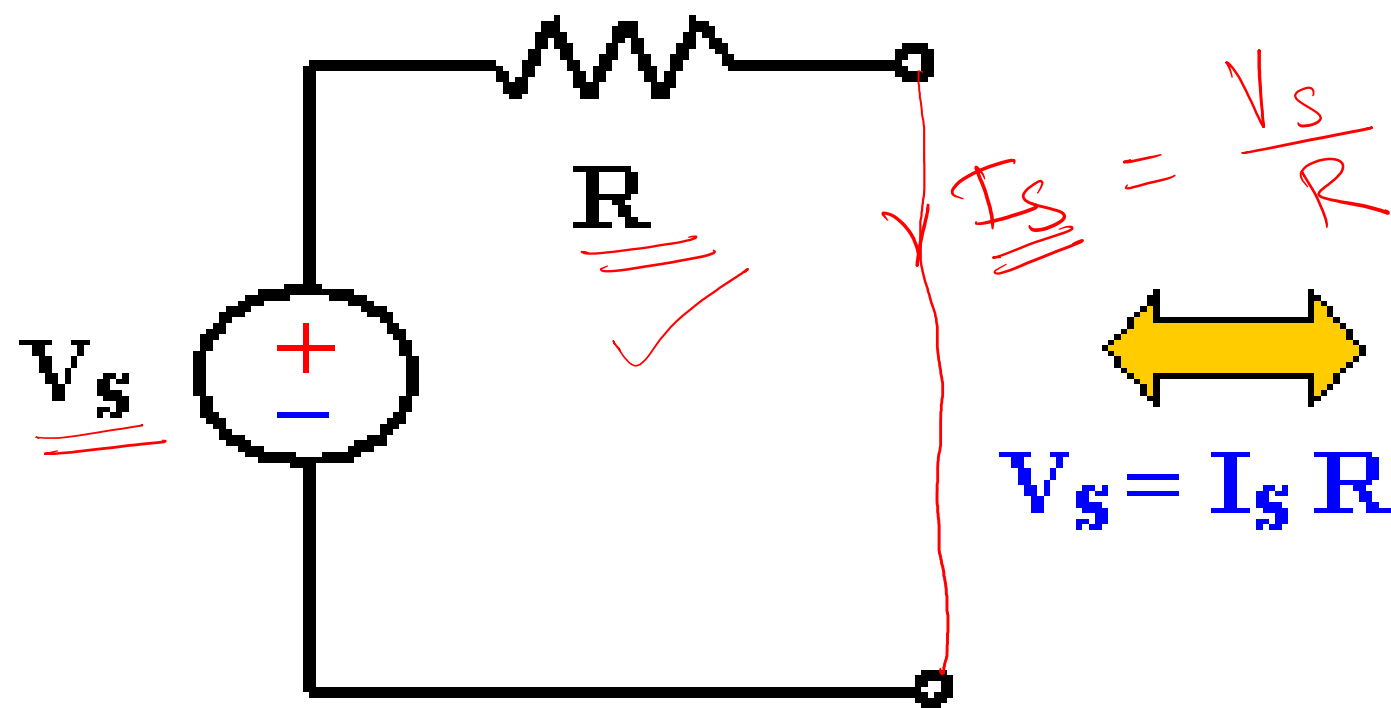
# Objective

- To introduce learners to source transformation techniques.
- To introduce the beginners to mesh current analysis.

# Source Transformation

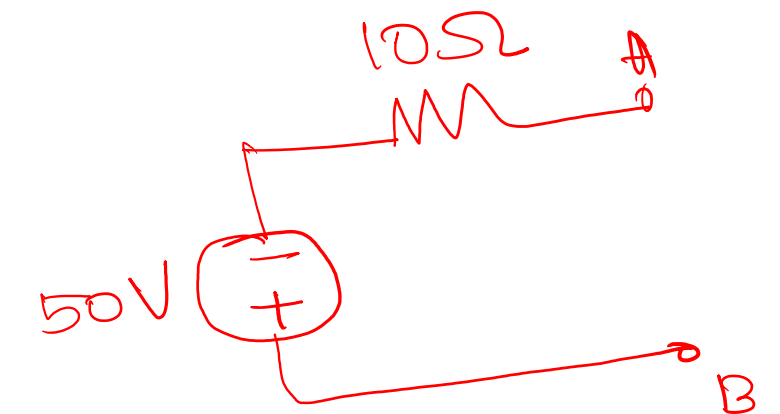
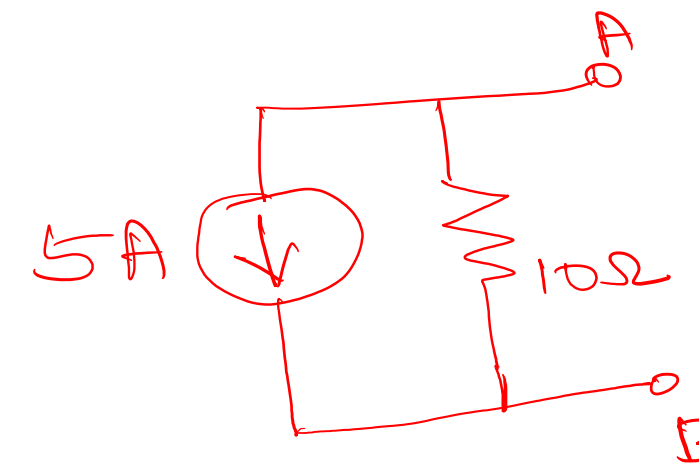
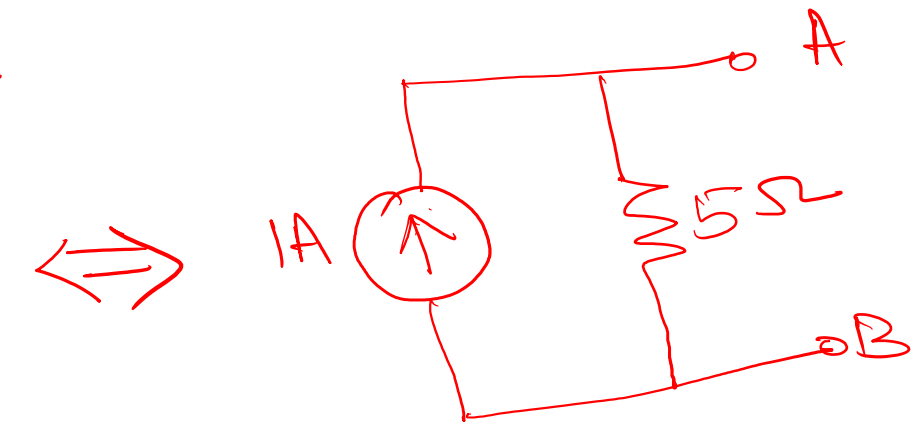
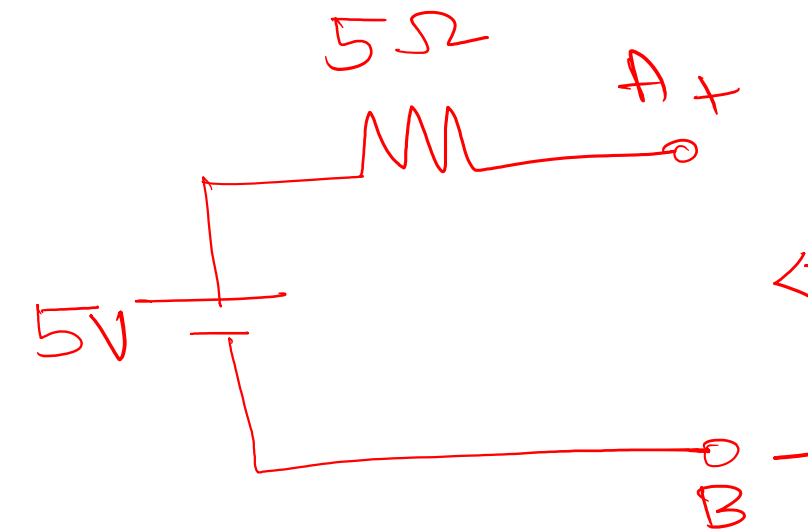
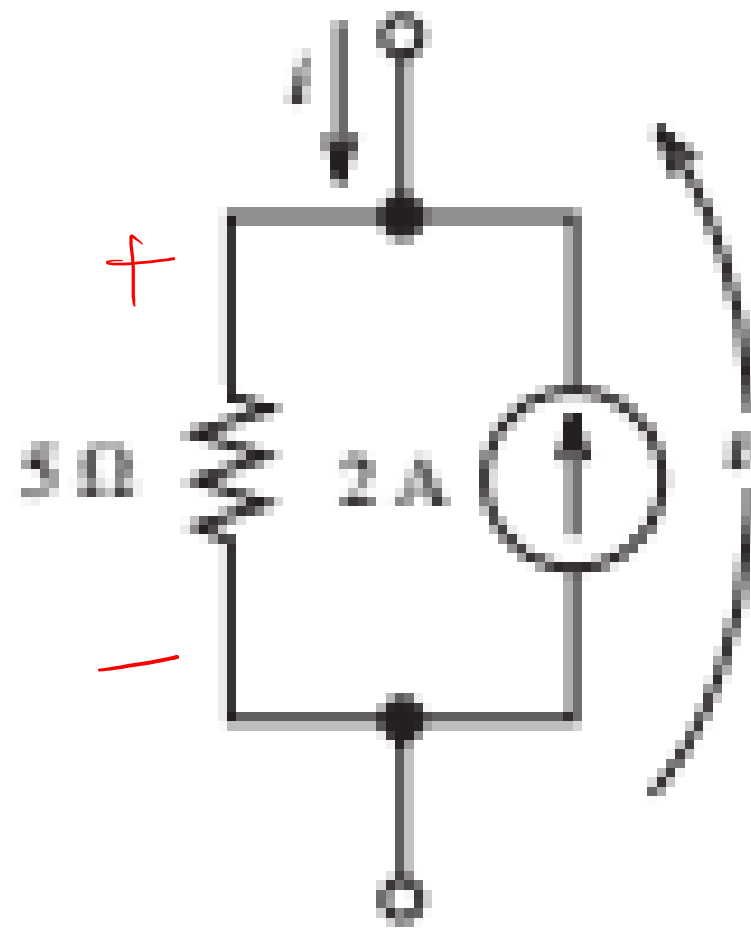
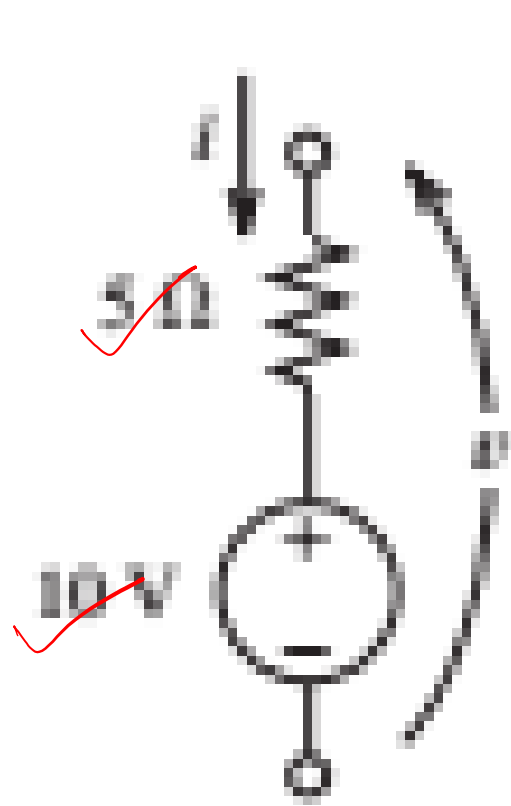
- Voltage source and current sources are interconvertible.
- Conversion is applied to simplify analysis of the circuit.
- Tedious calculations can be eliminated if adopted properly.
- A voltage source with an internal resistance 'R' can be converted into equivalent current source of magnitude  $I_s = V_s/R$ , in parallel with resistance R and vice-versa.

$$V = IR$$
$$I = \frac{V}{R}$$



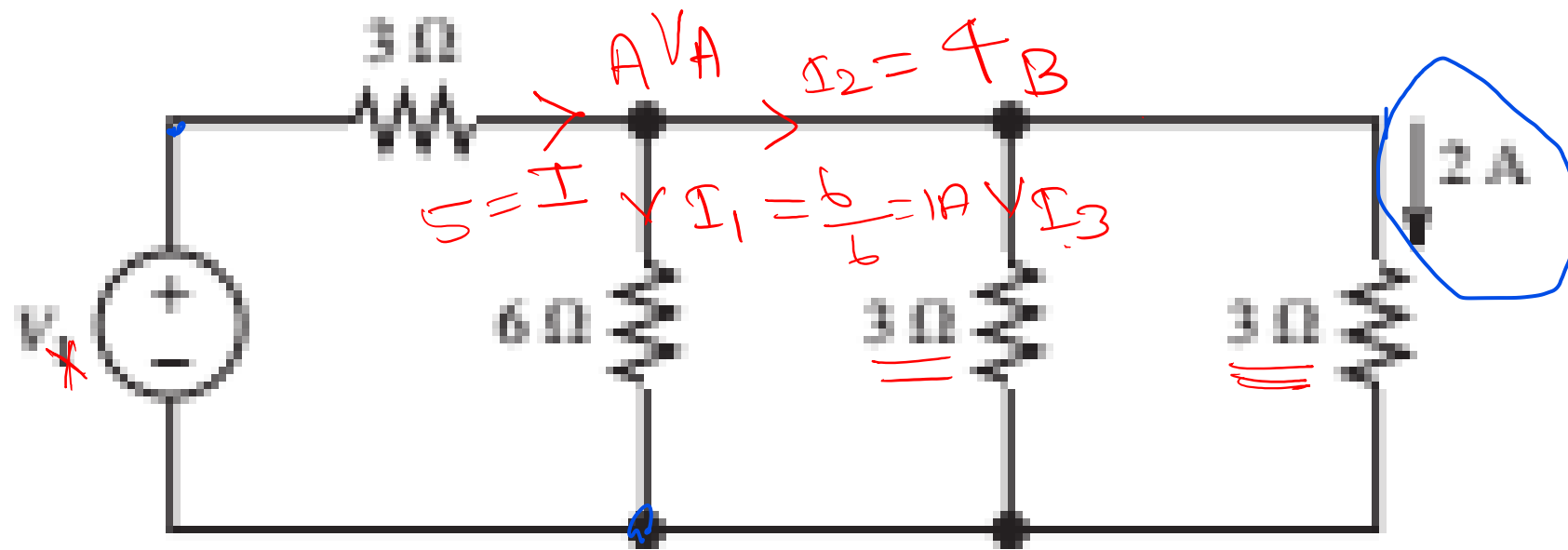
# Example 1:

- Is both the circuits identical? *Yes*



# Example 2:

Consider the circuit in figure and find  $V_x$ . (Hint: Use ohm's and Kirchhoff's law)



Applying KCL at node A

$$I = I_1 + I_2 \quad \text{--- (1)}$$

@ node B  $I_2 = I_3 + 2A \rightarrow \text{(2)}$

Sub (2) in (1)

$$I = I_1 + I_3 + 2 = 1 + 2 + 2 = 5A$$

Voltage  $V_{3\Omega} = I \times 3 = 5 \times 3 = 15V$

$$\therefore V_x = V_{3\Omega} + V_A = 15 + 6 = 21V$$

$$\boxed{V_x = 21V}$$

By KVL,  $V_x = V_{3\Omega} + V_A$

By ohm's law, Voltage of  $V_A$  is  $3\Omega \times 2A = 6V$

$$\therefore I_{6\Omega} = \frac{6}{6} = 1A$$

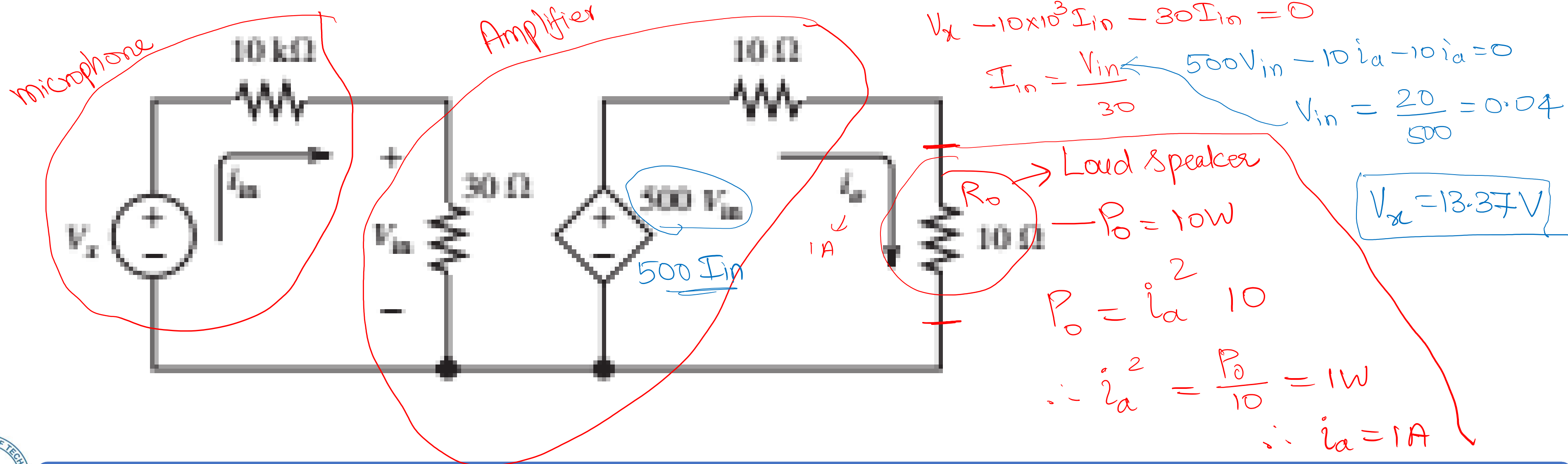
$$I_{3\Omega} = 2A$$

# Example 3:

$$V_x - 10000 \times \frac{0.04}{30} - 0.04 = 0$$

$$V_x - 13.33 - 0.04 = 0$$

The circuit shown in Figure is the electrical model for an electronic megaphone, in which the  $10\ \Omega$  resistance models a loudspeaker, the source  $V_x$  and the  $10\ \text{k}\Omega$  resistance represent a microphone, and the remaining elements model an amplifier. Given that the power delivered to the  $10\ \Omega$  resistance is  $10\ \text{W}$ , determine the current circulating in the right-hand loop of the circuit. Also, determine the value of the microphone voltage  $V_x$ .





# Introduction to Mesh, Loop, Node:

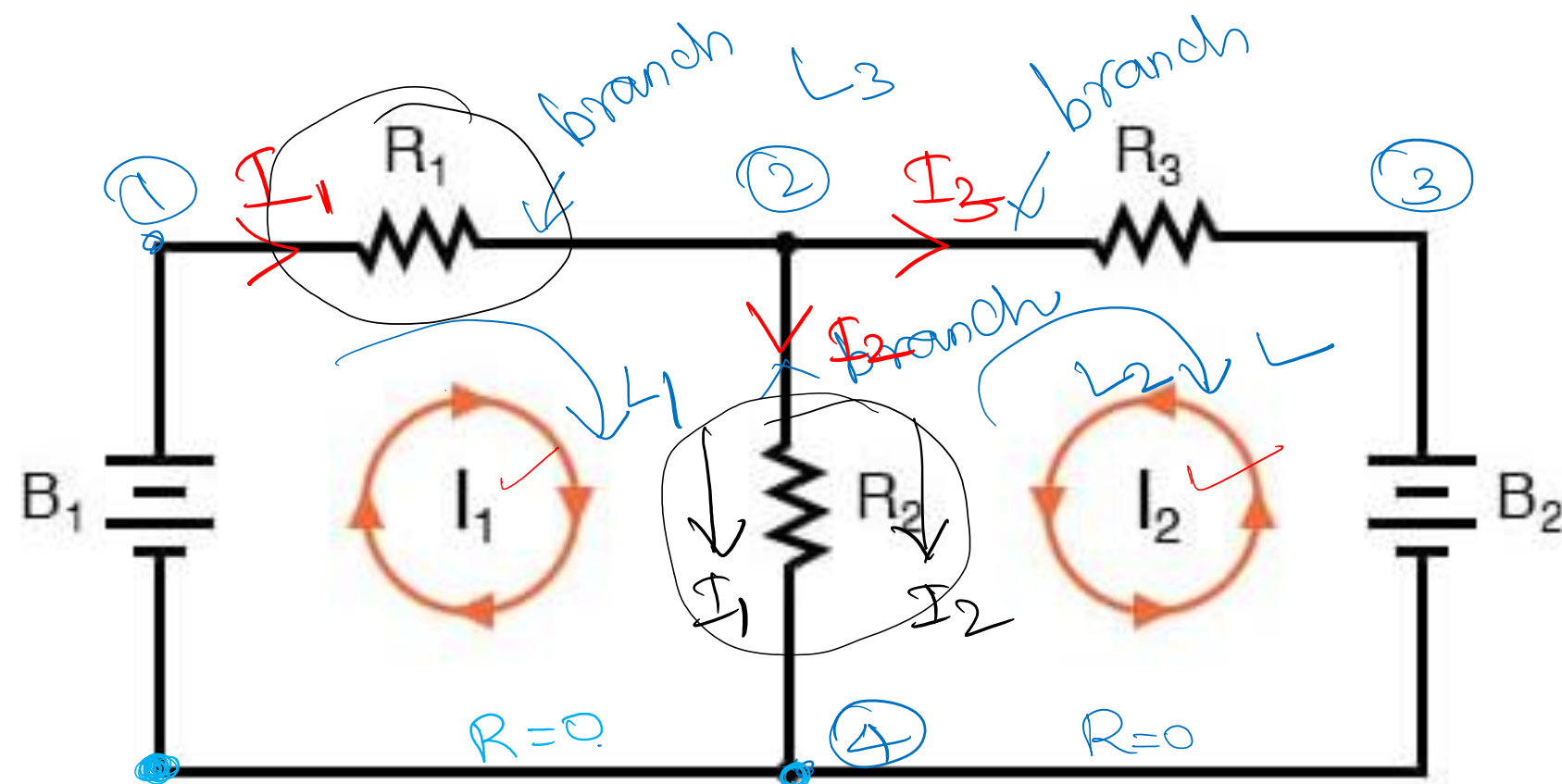
$I_1, I_2, I_3$  - branch currents

No. of nodes = 4       $I_1, I_2$  - loop currents

**Loop:** It is a closed path in a circuit

**Mesh:** it is a closed path in a circuit that doesn't contains any loop in it.

**Node:** It is the junction point of two or more elements in a circuit.



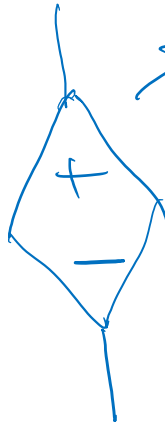
No. of loops : 3

$$L_1 - B, R_1, R_2$$
$$L_2 \rightarrow B_2 R_2 R_3$$
$$L_3: B, R, R_3 B_2$$

No. of Mesh: 02

$$M_1: B_1 R_1 R_2 \quad M_2: B_2 R_2 R_3$$

dependent  
voltage source


$$k V_x = \underbrace{500}_k V_{in}$$
$$R I_x = \underbrace{500}_R I_{in}$$

dependent current source

$K I_x = \underbrace{500}_{K} I_{in}$

$\frac{1}{R} V_x = \underbrace{500}_{1/R} V_{in}$

Current through  $R_2$  is

$$I_2 = I_1 + I_2$$
