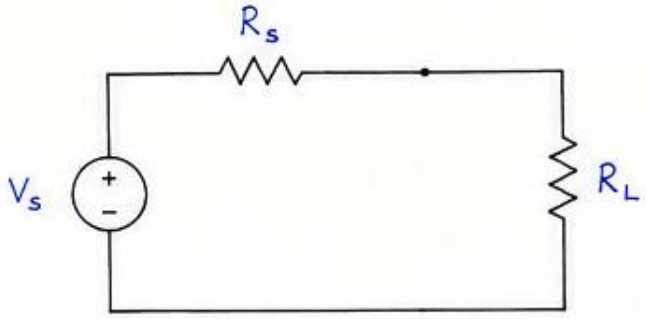
ASSIGNMENT QUESTIONS (MODULE 1)

1. Circuit Elements and Source Transformation

For the circuit shown below, the voltage source is V_s and resistances are R_s and R_L.



a) Transform the voltage source into an equivalent current source.

b) Calculate the load current I_L in both circuits.

c) Verify that both circuits give the same I_L.

d) State the conditions under which source transformation is valid.

For your roll number:

$V_s = 10 + (\text{Roll No. mod } 10)$ V

$R_s = 2 + (\text{Roll No. mod } 5)$ Ω

$R_L = 5 + (\text{Roll No. mod } 8)$ Ω

2. Classification of Electrical Devices

Identify whether each of the following devices is Active or Passive, Linear or Non-linear, Bilateral or Unilateral.

(a) Resistor

(b) Silicon Diode

(c) BJT Transistor

(d) Operational Amplifier

(e) LED

(f) Ideal Inductor

(g) Solar Cell

(h) MOSFET

For any THREE devices from the above list,

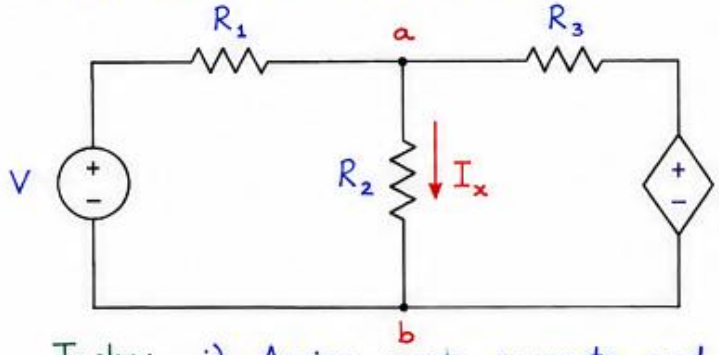
i) Draw their V-I characteristics.

ii) Justify why they belong to the selected category.

iii) Mention one practical application.

3. Mesh Analysis with Dependent Source

For the circuit shown below,



$V = 20 + (\text{Roll No. mod } 15)$ V

$R_1 = 4\,\Omega$, $R_2 = 6\,\Omega$, $R_3 = 8\,\Omega$

$k = 2 + (\text{Roll No. mod } 4)$

Tasks:

i) Assign mesh currents and write mesh equations.

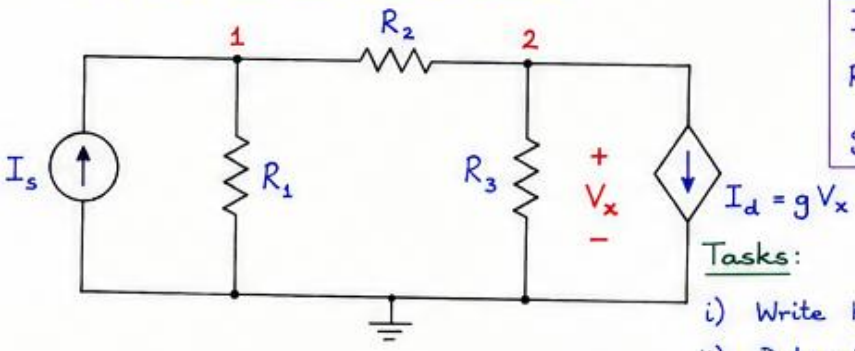
ii) Determine all branch currents.

iii) Calculate the power delivered by each source.

iv) Verify power balance.

4. Node Analysis with Dependent Current Source

For the circuit shown below,



$I_s = 2 + (\text{Roll No. mod } 5)$ A

$R_1 = 4\,\Omega$, $R_2 = 6\,\Omega$, $R_3 = 8\,\Omega$

$g = 0.2 + 0.05(\text{Roll No. mod } 6)$ S

Tasks:

i) Write KCL equations at the node(s).

ii) Determine node voltages V_1 and V_2.

iii) Calculate all branch currents.

iv) Verify KCL at every node.

v) Calculate power absorbed by each resistor.

5. Duality and Dual Networks

A network is given which consists of one voltage source, three resistors, one inductor and one capacitor connected in any form.

Tasks:

i) Draw the given network (choose your own values).

ii) Construct its dual network.

iii) Prepare a table showing the dual relationships between the following quantities:

Voltage ⟷ Current	Inductance (L) ⟷ Capacitance (C)
KVL ⟷ KCL	Series ⟷ Parallel
Mesh ⟷ Node	Open circuit ⟷ Short circuit
Resistance ⟷ Conductance ($1/R$)	Current source ⟷ Voltage source

iv) Explain why the obtained network is called the dual of the original circuit.

v) Mention two practical applications of network duality.

How to Calculate Parameter Values Using MOD (%)

The symbol **mod** (or %) means **remainder after division**.

Example

Suppose your **Roll Number** = **25103154001**

Then,

- **Roll No. mod 10**

$$25103154001 \div 10 = 2510315400 \text{ remainder } 1$$

$$25103154001 \bmod 10 = 1$$

- **Roll No. mod 5**

$$25103154001 \div 5 = 5020630800 \text{ remainder } 1$$

$$25103154001 \bmod 5 = 1$$

Hence, for **Roll No. 25103154001**,

$$V_s = 10 + (1) = 11 \text{ V}$$

$$R_s = 2 + (1) = 3\Omega$$

$$R_L = 5 + (1) = 6\Omega$$