Exam 1 Crib Sheet

Ohm's Law – Linear relationship between voltage and current in a resistor

V = I R

V – Voltage, Volts [V]

I – Current, Amps [A]

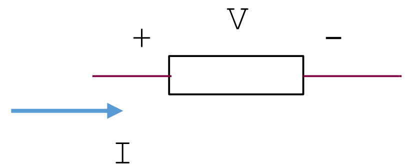
R – Resistance, Ohms [Ω]

Node – a connection between two or more components
Loop – a closed path through which current can flow

Power

P = V I

P – Power, Watts [W]



Using the above polarities (which may ot be correct)

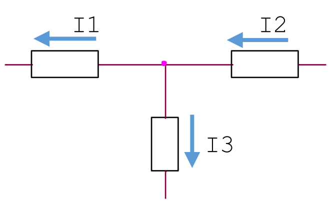
For P > 0, the component consumes power

For P < 0, the component produces power

KCL – Kirchoff's Current Law

$$\sum_{n=1}^{N} I_n = 0$$

The sum of the currents leaving a node is zero (signs determined by polarity).

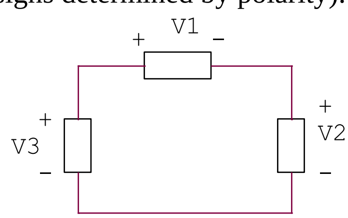


I1 - I2 + I3 = 0

KVL – Kirchoff's Voltage Law

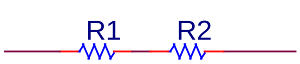
$$\sum_{n=1}^{N} V_n = 0$$

The sum of the voltages around any closed loop is zero (signs determined by polarity).

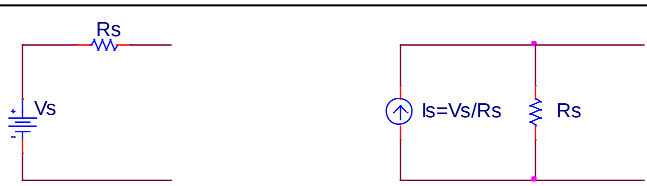


V1 + V2 - V3 = 0

Resistors in series – $R_{EQ} = R1 + R2$



Resistors in parallel - $R_{EQ} = \left(\frac{1}{R1} + \frac{1}{R2} \right)^{-1}$



Source transformation

<u>Voltage divider (two resistors in series)</u>
V_{R1}= Vsource x [R1/(R1+R2)]

<u>Current divider (two resistors in parallel)</u>
I_{R1} = Isource x [R2/ (R1+R2)]

Superposition – For each **independent** source, turn off all other **independent** sources ***<u>(to turn off: Voltage source becomes a short circuit and Current source becomes an open circuit)</u>*** and find the contribution from that source. Sum the contribution from each source to get the parameter of interest.

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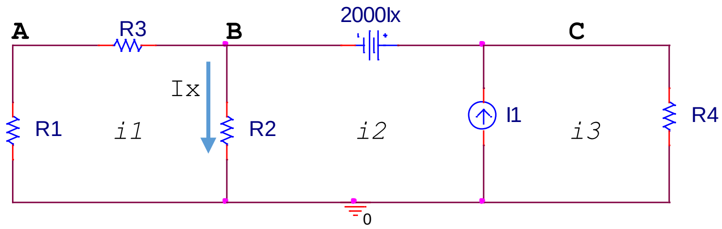
Node Analysis

of KCL Equations = Total # of nodes – voltage sources -1



Mesh Analysis

of KVL Equations = Total # mesh loops – current sources

$$\frac{V_A}{R1}+\frac{V_A-V_B}{R3}=0$$

$$\frac{V_B}{R2}+\frac{V_B-V_A}{R3}-I_1+\frac{V_C}{R4}=0$$

$$V_C-V_B=2000I_x$$

$$\frac{V_B}{R2}=I_x$$

$$(i_1)R1+(i_1)R3+(i_1-i_2)R2=0$$

$$-2000I_x+(i_3)R4+(i_2-i_1)R2=0$$

$$i_3-i_2=I_1$$

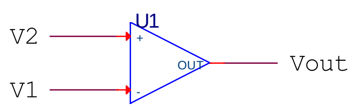
$$i_1-i_2=I_x$$

Example includes a Current Controlled Voltage Source (CCVS) as a dependent source and I1 as an independent source.

Thevenin voltage (**V_{TH}**) – **Open** circuit the load, find the voltage across the load nodes
Norton current (**I_N**)– **Short** circuit the load, find the current through that short circuit
Thevenin resistance (**R_{TH}**) – Turn off all **independent** sources, replace the load with a test voltage (Vtest), find the current (Itest) through the test voltage, R_{TH} = Vtest/Itest.

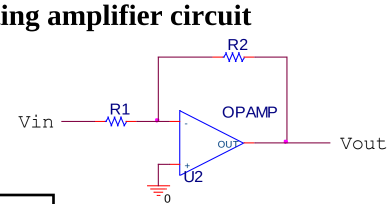
$V_{TH} = I_N R_{TH}$ (Ohm's Law relationship)

Comparator



If V1 < V2 , Vout = $V^{+}_{saturation}$
If V1 > V2 , Vout = $V^{-}_{saturation}$

Inverting amplifier circuit

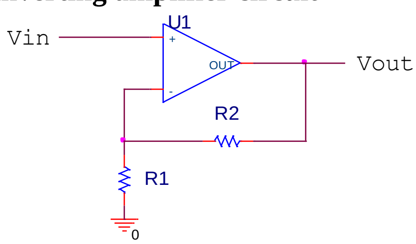


$$Vout=-\frac{R2}{R1}Vinn$$

<u>Ideal op amp equations</u>

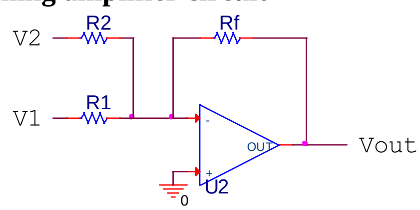
$I_N = I_P = 0$ no current draw Rin = ∞
$V_P = V_N$ (A -> ∞)
Rout = 0

Non-inverting amplifier circuit



$$Vout=\left(1+\frac{R2}{R1}\right)Vinn$$

Summing amplifier circuit



$$Vout=-\frac{Rf}{R1}V1-\frac{Rf}{R2}V2$$