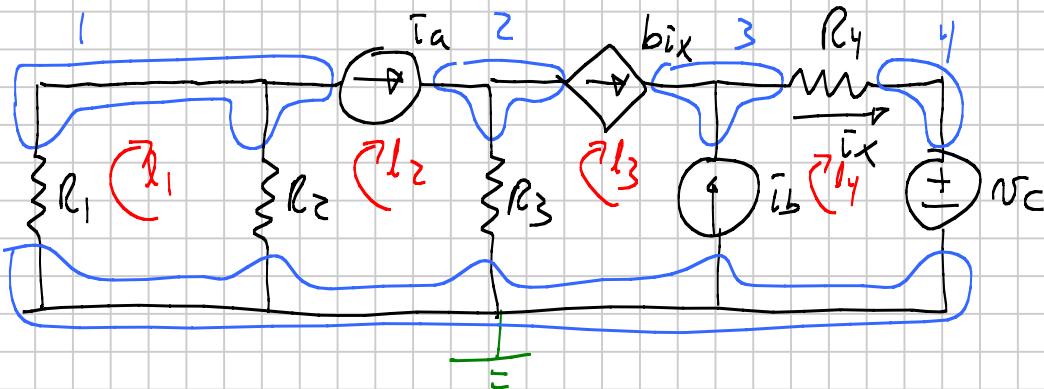


EGR 119 Test | Spring 2009

Note Title

1)



Need i_x ; can find at n_3 : KCL $|_{n_3}$: $-b\bar{I}_x - \bar{I}_b + \bar{I}_x = 0$

Node voltages:

$$i_x = \frac{\bar{I}_b}{1-b}$$

$$V_{n_4} = V_C$$

$$V_{n_3} = V_C + R_4 i_X$$

$$V_{n_2} = R_3 (\bar{I}_a - b\bar{I}_x)$$

$$V_{n_1} = -\bar{I}_a (R_1 || R_2)$$

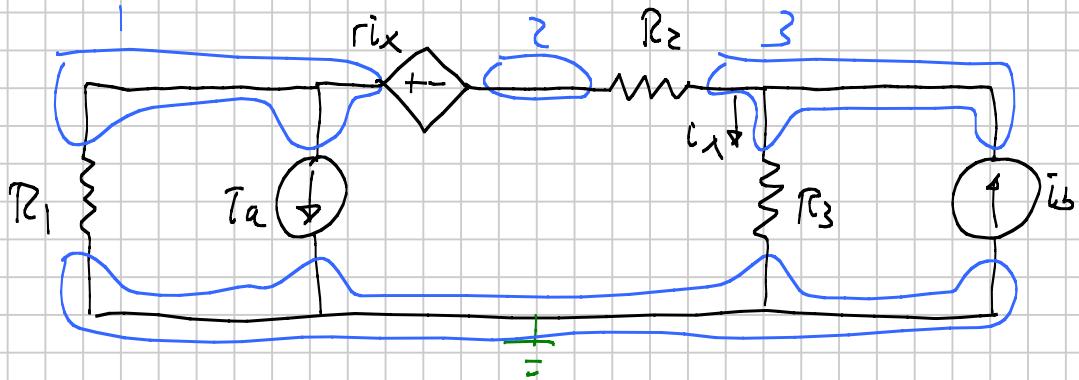
$$1) P_{abs, I_a} = (V_{n_1} - V_{n_2}) \bar{I}_a = (-\bar{I}_a (R_1 || R_2) - R_3 (\bar{I}_a - b\bar{I}_x)) \bar{I}_a$$

$$2) P_{abs, I_b} = -V_{n_3} \bar{I}_b = -[V_C + R_4 i_X] \bar{I}_b$$

$$3) P_{abs, V_C} = \bar{I}_X V_C$$

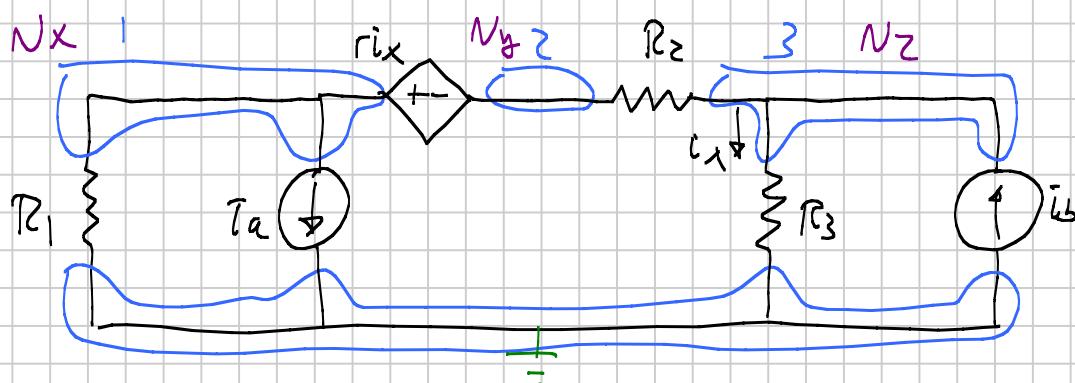
$$4) P_{abs, cccs} = (V_{n_2} - V_{n_3}) b\bar{I}_x = (R_3 (\bar{I}_a - b\bar{I}_x) - (V_C + R_4 i_X)) b\bar{I}_x$$

2)



- 1) GND
- 2) NODES
- 3) NODE VOLTAGES

Several options here; main choice is whether V_{n_3} is its own unknown or is $R_3 i_x$
 "most general" is



Unknowns: N_x, N_y, N_z, i_x

Eqs:

Control : $i_x = N_z / R_3$

AUX : $N_x - N_y = r i_x$

PICK 2 of these 3

KCL, n_3 : $\frac{N_z - N_y}{R_2} + \frac{N_z}{R_3} - I_b = 0$

KCL, $s_{n_1 z}$: $\frac{N_x}{R_1} + I_a + \frac{N_y - N_z}{R_2} = 0$

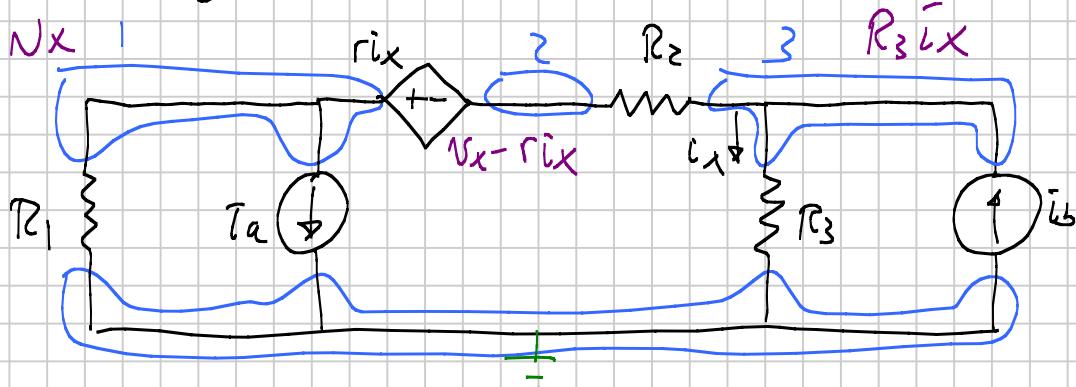
KCL, $s_{n_1 z}$: $\frac{N_x}{R_1} + I_a + \frac{N_z}{R_3} - I_b = 0$

$$P_{abs, R_2} = (N_y - N_z)^2 / R_2$$

$$P_{del, CCVS} = N_{CCVS} I_{CCVS} = (r i_x) \left(\frac{N_z - N_y}{R_2} \right)$$

$$= \left(\frac{r N_z}{R_3} \right) \left(\frac{N_z - N_y}{R_2} \right)$$

Alternatively



Unknowns : N_x, i_x

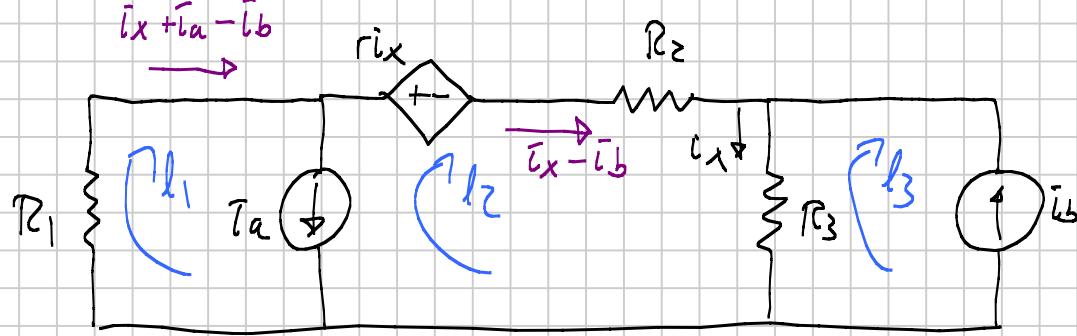
$$\left\{ \begin{array}{l} KCL, n_3 : R_3 i_x - \frac{N_x - r_i x}{R_2} + \bar{i}_x - \bar{i}_b = 0 \\ KCL, s_{n_12} : \frac{N_x}{R_1} + \bar{i}_b + \frac{(N_x - r_i x) - R_2 i_x}{R_2} = 0 \\ KCL, s_{n_123} : \frac{N_x}{R_1} + \bar{i}_a + \bar{i}_x - \bar{i}_b = 0 \end{array} \right.$$

Pick 2 out of

$$P_{abs, R_2} = (R_3 i_x - N_x + r_i x)^2 / R_2$$

$$P_{del, VCCS} = N_{VCCS} i_{VCCS} = r_i x \underbrace{(R_3 i_x - (N_x - r_i x)) / R_2}_{}$$

3)



$$KVL, sl_{12} : R_1(i_x + i_a - i_b) + r i_x + R_2(i_x - i_b) + R_3 i_x = 0$$

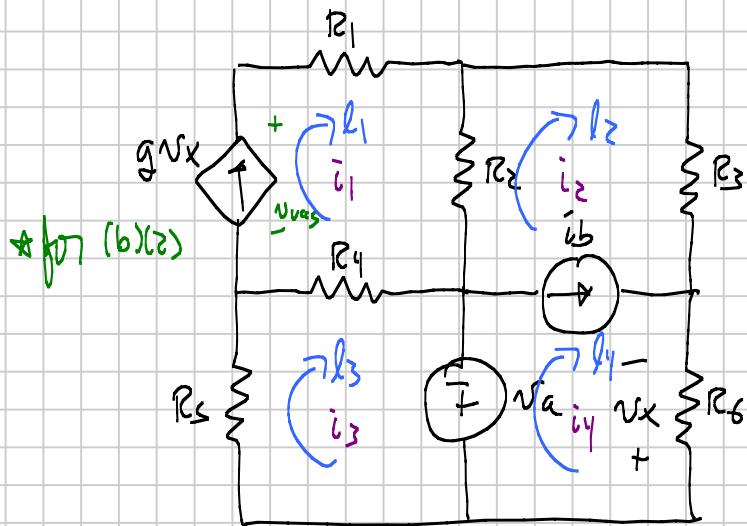
$$(R_1 + R_2 + R_3 + r)i_x = -R_1 i_a + (R_1 + R_2)i_b$$

$$r i_x = \underbrace{-\frac{R_1 i_a + (R_1 + R_2) i_b}{R_1 + R_2 + R_3 + r}}$$

(1) $P_{\text{del,ccvs}} = -(r i_x)(i_x - i_b)$ (passive sign conv; needs
- for dep)

(2) $P_{\text{abs}, R_1} = (i_x + i_a - i_b)^2 R_1$

4)



1) Loops
2) Mesh currents

Unknowns: i_1, i_2, i_3, i_4, v_x

$$\text{Control: } v_x = -R_6 \bar{i}_4$$

$$\text{AVX: } \bar{i}_1 = g v_x$$

$$(\bar{i}_4 - \bar{i}_2) = \bar{i}_5$$

PICK 2 of 3

$$\left\{ \begin{array}{l} \text{KVL, l}_3: R_5(\bar{i}_3) + R_4(i_3 - \bar{i}_1) - v_a = 0 \\ \text{KVL, l}_2: v_a + R_2(i_2 - \bar{i}_1) + R_3 i_2 + R_6 \bar{i}_4 \\ \text{KVL, l}_3: R_5(i_3) + R_4(i_3 - \bar{i}_1) + R_2(i_2 - \bar{i}_1) + R_3(i_2) + R_6(i_4) \end{array} \right.$$

$$(1) P_{abs, R_2} = (\bar{i}_1 - \bar{i}_2)^2 R_2$$

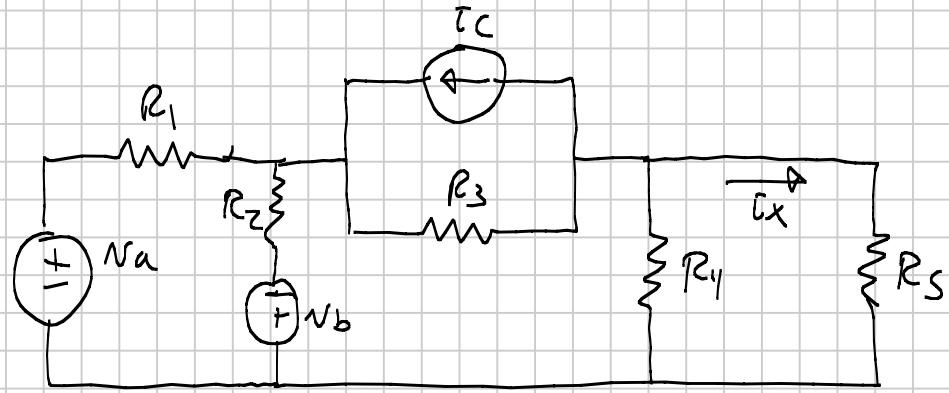
$$(2) P_{abs, VCCS} = \text{need to get } v_{VCCS}$$

$$\text{KVL, l}_1: -v_{VCCS} + R_1 \bar{i}_1 + R_2(\bar{i}_1 - \bar{i}_2) + R_4(\bar{i}_1 - i_3) = 0$$

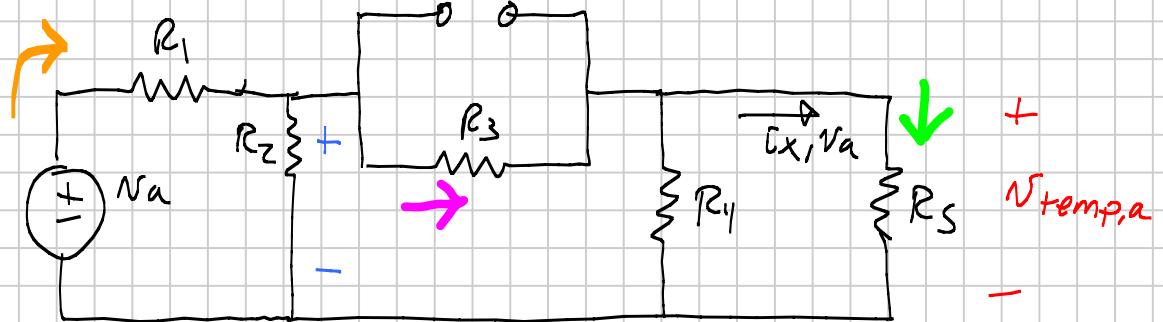
$$v_{VCCS} = R_1 \bar{i}_1 + R_2(\bar{i}_1 - \bar{i}_2) + R_4(\bar{i}_1 - i_3)$$

$$P_{abs, VCCS} = v_{VCCS} \underline{\bar{i}_1}$$

5)



Va:

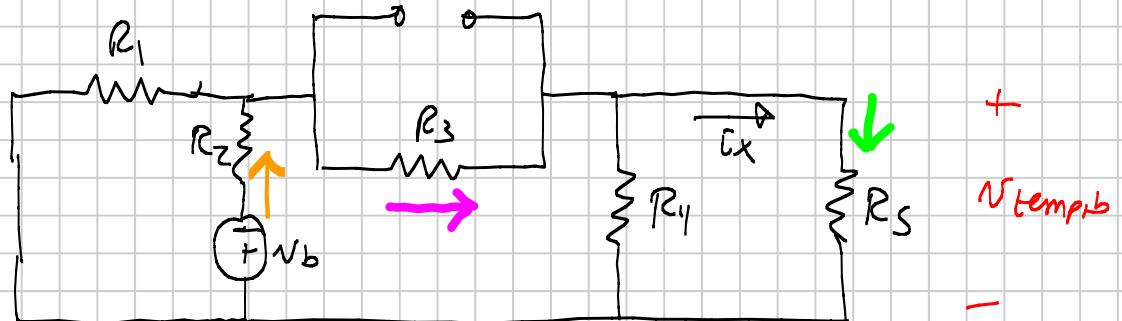


$$V_{\text{temp},a} = V_a \left(\frac{R_2 \parallel (R_3 + (R_4 \parallel R_S))}{R_1 + (R_2 \parallel (R_3 + (R_4 \parallel R_S)))} \right) \left(\frac{R_4 \parallel R_S}{R_3 + (R_4 \parallel R_S)} \right); i_{X,va} = \frac{V_{\text{temp},a}}{R_S}$$

or, note $R_{\text{eq}} = R_1 + (R_2 \parallel (R_3 + (R_4 \parallel R_S)))$ and use current division

$$i_{X,va} = \left(\frac{V_a}{R_1 + (R_2 \parallel (R_3 + (R_4 \parallel R_S)))} \right) \left(\frac{R_2}{R_2 + R_3 + (R_4 \parallel R_S)} \right) \left(\frac{R_4}{R_4 + R_S} \right)$$

Vb:

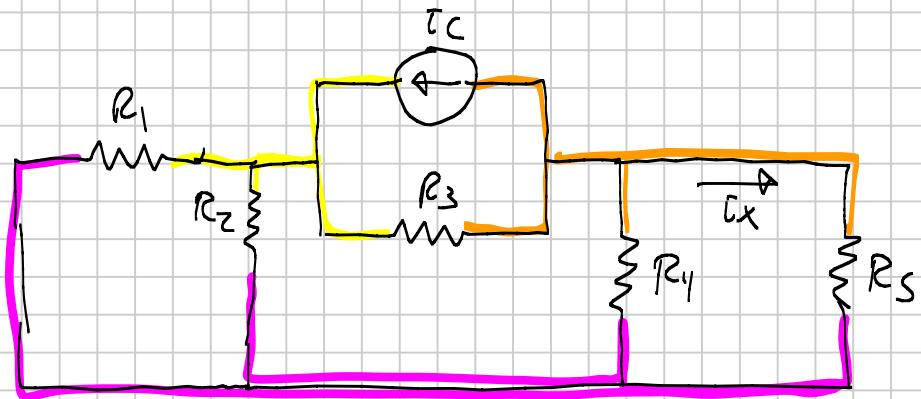


$$V_{\text{temp},b} = -V_b \left(\frac{R_1 \parallel (R_3 + (R_4 \parallel R_S))}{R_2 + (R_1 \parallel (R_3 + (R_4 \parallel R_S)))} \right) \left(\frac{R_4 \parallel R_S}{R_3 + (R_4 \parallel R_S)} \right) i_{X,vb} = \frac{V_{\text{temp},b}}{R_S}$$

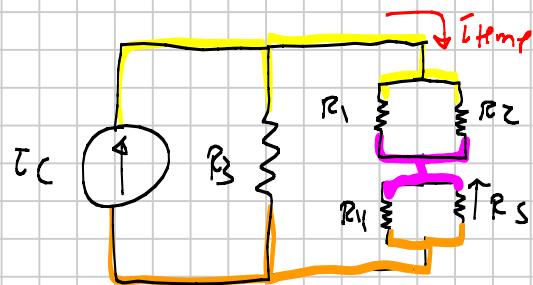
or, note $R_{\text{eq}} = R_2 + (R_1 \parallel (R_3 + (R_4 \parallel R_S)))$ and use current division

$$i_{X,vb} = \left(\frac{-V_b}{R_2 + (R_1 \parallel (R_3 + (R_4 \parallel R_S)))} \right) \left(\frac{R_1}{R_1 + R_2 + (R_4 \parallel R_S)} \right) \left(\frac{R_4}{R_4 + R_S} \right)$$

T_C



Redraw:



$$\bar{R}_{temp} = T_C \left(\frac{R_3}{R_3 + ((R_1||R_2) + (R_4||R_5))} \right)$$

$$\bar{i}_{x_{eq}} = -\bar{R}_{temp} \left(\frac{R_4}{R_4+R_S} \right) = -\bar{R}_{temp} \left(\frac{R_3}{R_3 + ((R_1||R_2) + (R_4||R_5))} \right) \left(\frac{R_4}{R_4+R_S} \right)$$

$$\bar{i}_x = \bar{i}_{1,va} + \bar{i}_{1,vb} + \bar{i}_{x,T_C}$$