

ECE Fall 2019 Test I

Note Title

10/14/2019

I (1)

$$A\bar{B}CD + \bar{A}\bar{B}CD + A\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D}$$

1 0 1 1	0 0 1 1	1 1 0 1	0 0 0 1	1 0 0 1
11	3	13	1	9

so : 1, 3, 9, 11, 13

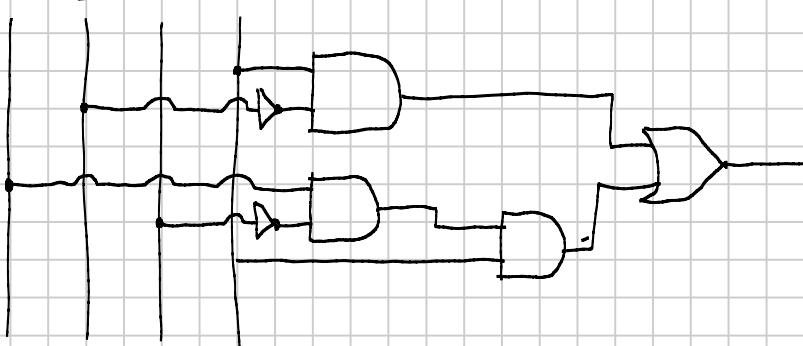
(2)

		CD		AB			
		00	01	11	10		
AB	CD	00	0	1	1	0	
		01	0	0	0	0	
AB	CD	11	0	1	0	0	
		10	0	1	1	0	

(3) Using • and • $f = \bar{B}D + A\bar{C}D$

(4)

A B C D



(5) 6 GATES + 10 INPUTS = 16 or $3 \times 4 \text{ ANDOR} + 2 \times 2 \text{ NOT} = 16$

(6)

		CD		AB			
		00	01	11	10		
AB	CD	00	0	1	1	0	
		01	0	0	0	0	
AB	CD	11	0	1	0	0	
		10	0	1	0	0	

$$f = \bar{D} + \bar{A}B + BC$$

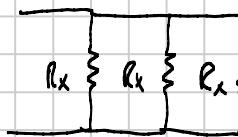
$$f = (D)(A + \bar{B})(\bar{B} + \bar{C})$$

II

(1) $R_{eq} = 2 \text{ m}\Omega \quad p = .05 \text{ W}$

$$I^2 R_{eq} = p; \quad i = \sqrt{\frac{p}{R_{eq}}} = \sqrt{\frac{.05}{2000}} = \sqrt{\frac{1}{40000}} = \frac{1}{200} = .005 A$$

(2) $p = iV, \quad V = \frac{p}{i} = \frac{.05}{.005} = 10 V$

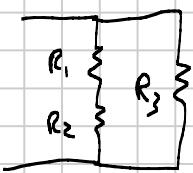
(3) Since $R_{eq} < R_x$, must be some in parallel:

$$\frac{1}{R_x} + \frac{1}{R_x} + \frac{1}{R_x} = \frac{R_x}{3}$$

not
this

$$\frac{1}{2R_x} + \frac{1}{R_x} = \frac{2R_x}{3} \checkmark$$

(d)



$$V_{R_1} = V_{R_2} = \frac{1}{2} 10V = 5V, \quad V_{R_3} = 10V$$

$$P_{abs,R_1} = P_{abs,R_2} = \frac{V^2}{R} = \frac{25}{3000} W = 8.3 \text{ mW each}$$

$$P_{abs,R_3} = \frac{V^2}{R} = \frac{100}{3000} W = 33.3 \text{ mW}$$

note $\sum P_{abs,R_i} = 50 \text{ mW} = p_{del}!$

$$\begin{aligned} R_{234S} &= R_3 \parallel (R_4 \parallel (R_2 + R_S)) \\ R_{24S} &= R_4 \parallel (R_2 + R_S) \end{aligned}$$

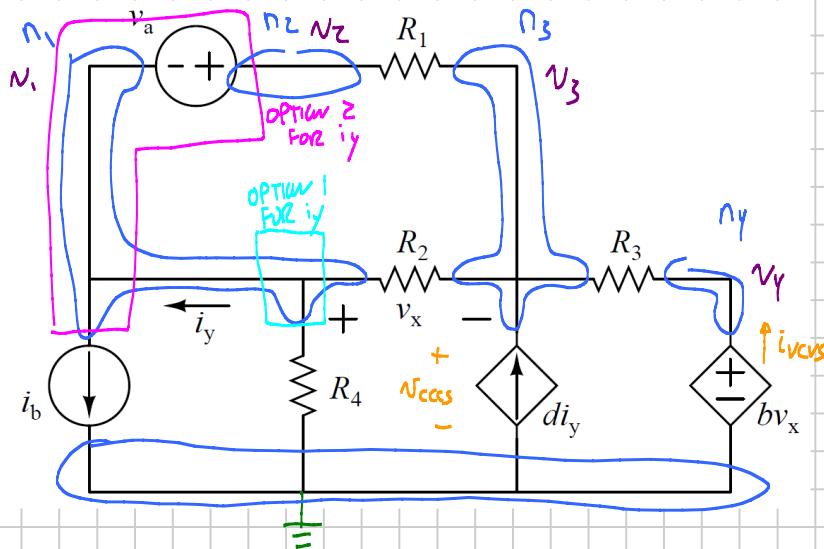
$$V_a = \frac{V_s R_1}{R_1 + R_{234S}} \quad V_b = -\frac{V_s R_{234S}}{R_1 + R_{234S}} \quad V_c = -\frac{V_b R_2}{R_2 + R_S}$$

$$\begin{aligned} R_{134} &= R_1 + (R_3 \parallel R_4) \\ R_{25} &= R_2 + R_S \end{aligned}$$

$$i_x = \frac{R_{134} \parallel R_{25}}{R_{134}} \quad \frac{R_3 \parallel R_4}{R_3} i_p \quad i_y = \frac{R_{134} \parallel R_{25}}{R_{134}} i_p \quad i_z = -\frac{R_{134} \parallel R_{25}}{R_{25}} i_p$$

三

- 1) GND
 - 2) NUDES
 - 3) N_{NODES}
 - 4) EQUATIONS



- not part of NVM

Unknowns: v_1 v_2 v_3 v_4 v_x i_y

$$KCL_{n_3} : \frac{V_3 - V_2}{R_1} + \frac{V_3 - V_1}{R_2} + \frac{V_3 - V_4}{R_3} - di_y = 0$$

$$KCL, s_1: \frac{V_2 - V_3}{R_1} + \frac{V_1 - V_3}{R_2} + \frac{V_1 - 0}{R_4} + i_b = 0$$

$$SRC, v_a : \quad v_a = v_2 - v_1$$

$$SRC_{vcvs} : \quad bN_x = N_y - 0$$

$$\text{MEAS } v_x: \quad N_x = N_1 - N_3$$

$$\text{MEAS } i_2: \text{ KCL @ junction above } R_2: i_2 + \frac{V_1 - 0}{R_1} + \frac{V_1 - V_2}{R_2} = 0$$

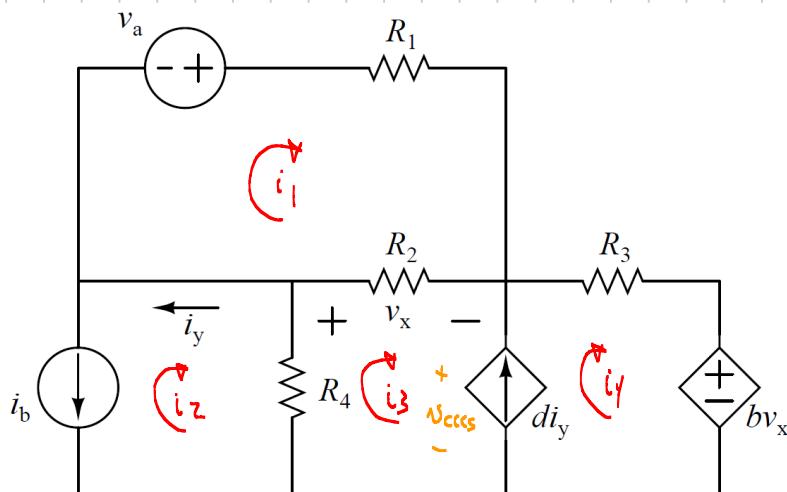
$$\text{on } KCLC \text{ superjunction : } -i_2 + i_b + \frac{V_2 - V_3}{R_1} = 0$$

$$(2) \quad P_{abs, RC_3} = \left(\frac{V_3 - V_4}{RC_3} \right)^2$$

$$P_{\text{def}, \text{cccs}} = (v_3 - 0)(\text{dig})$$

$$P_{\text{dil,vcus}} = (b \nu x) \left(\frac{\nu_f - \nu_i}{R_3} \right) \quad \text{using KCL only to get } i_{\text{vcus}}$$

MCM



$$KVL, l_1: -v_a + R_1 i_1 + R_2 (i_1 - i_3) = 0$$

$$KVL, l_34: R_4 (i_3 - i_2) + R_2 (i_3 - i_1) + R_3 i_y + b v_x$$

$$SRC, i_b: i_b = -i_2$$

$$SRC, cccs: di_y = i_y - i_3$$

$$MEAS, v_x: v_x = R_2 (i_3 - i_1)$$

$$MEAS, i_y: i_y = i_1 - i_2$$

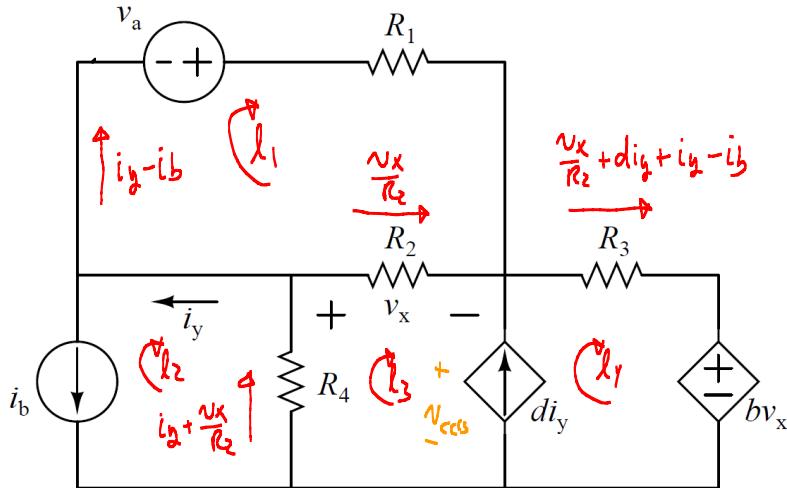
$$(2) P_{diss, R_3} = (i_y)^2 R_3$$

$$P_{diss, cccs} = (v_{cccs})(di_y)$$

$$P_{diss, v_x} = -(b v_x)(i_y)$$

$$\begin{aligned} KVL, l_3: R_4 (i_3 - i_2) + R_2 (i_3 - i_1) + v_{cccs} &= 0 \\ KVL, l_4: -v_{cccs} + R_3 i_y + b v_x &= 0 \end{aligned}$$

II BEM



4 meshes = 4 base currents
6 essential branches

$$KVL_{l_1}: -v_a + R_1(i_y - i_b) - v_x = 0$$

$$KVL_{l_3}: R_1(i_y + \frac{v_x}{R_2}) + v_x + R_3(\frac{v_x}{R_2} + d i_y + i_y - i_b) + b v_x = 0$$

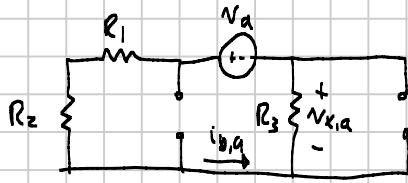
$$(2) P_{abs, R_3} = \left(\frac{v_x}{R_2} + d i_y + i_y - i_b \right)^2 R_3$$

$$\cancel{\text{P}_{\text{del,CCCS}} = (v_{\text{CCCS}})(d i_y)} \quad \text{get } v_{\text{CCCS}} \text{ from} \quad \begin{cases} KVL_{l_3}: R_1(i_b + \frac{v_x}{R_2}) + v_x + v_{\text{CCCS}} = 0 \\ \text{or} \\ KVL_{l_1}: -v_{\text{CCCS}} + R_3(\frac{v_x}{R_2} + d i_y + i_y - i_b) + b v_x = 0 \end{cases}$$

$$P_{\text{del,CCCS}} = -\left(\frac{v_x}{R_2} + d i_y + i_y - i_b \right) (b v_x)$$

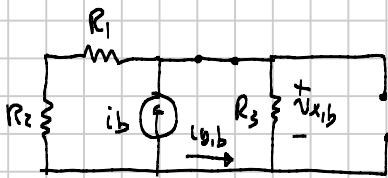
V

V_a :



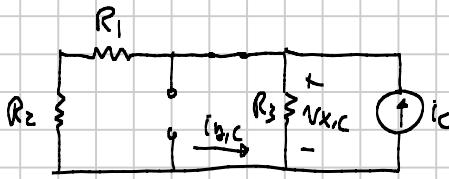
$$\left. \begin{aligned} V_{x,a} &= -\frac{V_a R_3}{R_1 + R_2 + R_3} \\ i_{y,a} &= \frac{V_a}{R_1 + R_2 + R_3} \end{aligned} \right\} \text{can use } V_{x,a} = -R_3 i_{y,a} \text{ for one}$$

i_b :



$$\left. \begin{aligned} V_{x,b} &= i_b (R_3 \parallel (R_1 + R_2)) \\ i_{y,b} &= -\frac{i_b ((R_1 + R_2) \parallel R_3)}{R_3} \end{aligned} \right\} \text{can use } V_{x,b} = -R_3 i_{y,b} \text{ for one}$$

i_c :

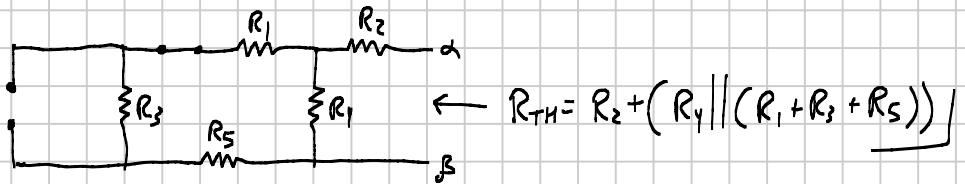


$$\left. \begin{aligned} V_{x,c} &= i_c (R_2 \parallel (R_1 + R_3)) \\ i_{y,c} &= i_c \frac{(R_1 + R_2) \parallel R_3}{R_1 + R_2} \end{aligned} \right\} \text{can use } V_{x,c} = (R_1 + R_2) i_{y,c} \text{ for one}$$

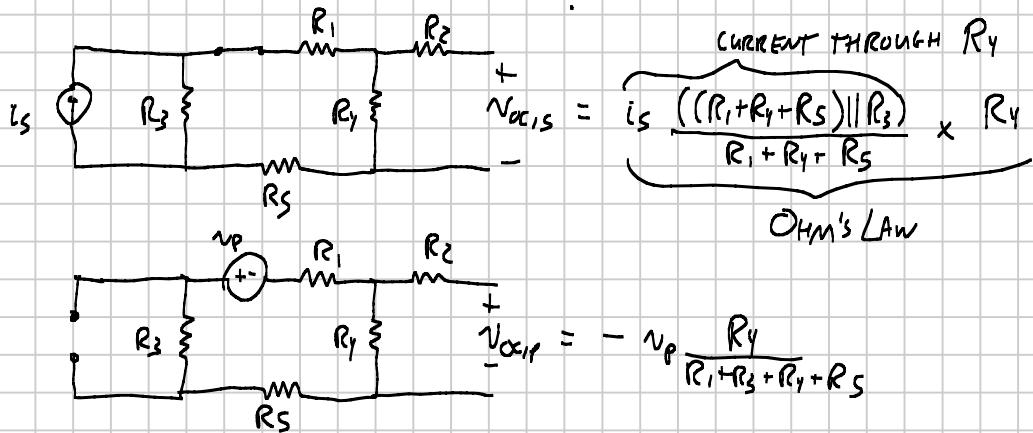
$$V_x = V_{x,a} + V_{x,b} + V_{x,c}$$

$$i_y = i_{y,a} + i_{y,b} + i_{y,c}$$

VI) Since only indep. Srcs, get R_{TH} by setting v_p & i_s to 0

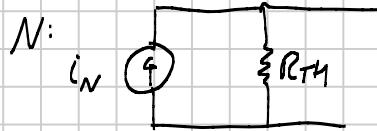
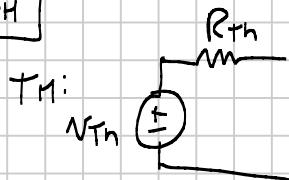


To get $v_{oc} \rightarrow$ SUPERPOSITION?



$$v_{th} = v_{oc} = v_{oc,i_s} + v_{oc,i_p}$$

$$i_N = \frac{v_{oc}}{R_{TH}}$$



$$(2) R_L = R_{TH} \checkmark$$

$$\rho_{abs} = \frac{(v_{oc}/2)^2}{R_L} = \frac{v_{th}^2}{4R_{TH}}$$