ECE 110 F2015 Test I

Note Title

I) 1) $F(A,B,C,D) = \bar{A}\bar{B}\bar{C}\bar{D}_{0} + \bar{A}B\bar{C}\bar{D}_{4} + AB\bar{C}\bar{D}_{12} + \bar{A}\bar{B}\bar{C}D_{1} + \bar{A}B\bar{C}D_{5} + A\bar{B}\bar{C}D_{9} + \bar{A}BC\bar{D}_{6} + ABC\bar{D}_{14}$

(a) $\Sigma_i\, m(0,1,4,5,6,9,12,14)$

(b)

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

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

(d)

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

$\bar{F} = C\bar{D} + \bar{B}C + A\bar{B}\bar{D} + AB\bar{D}$

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

2) $g(J,K,L) = \bar{L} + J\bar{K} + \bar{J}K$

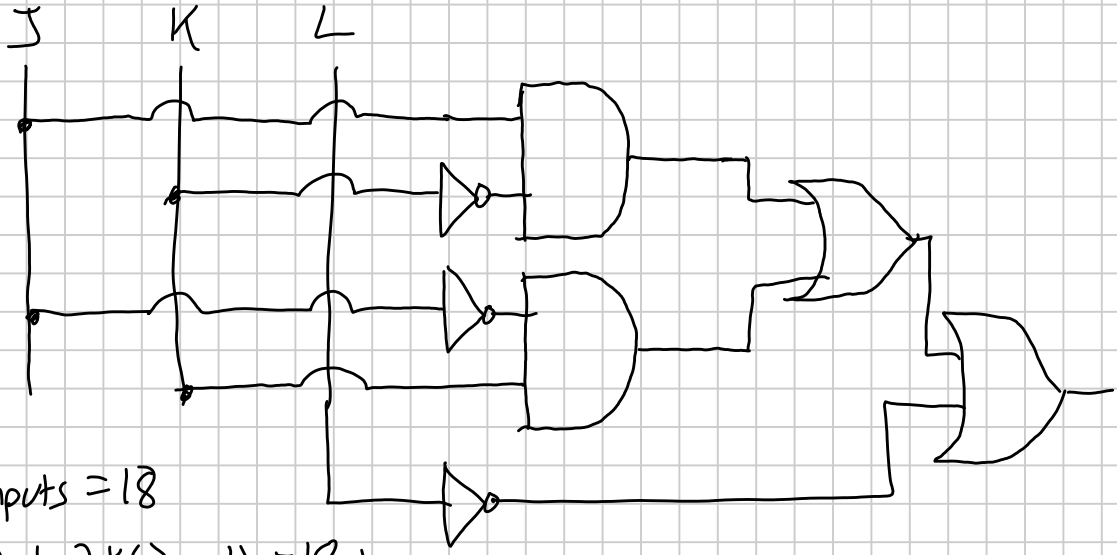
JK \ L	0	1
00	1	0
01	1	1
11	1	0
10	1	1

minterms:

0	1
2	3
6	7
4	5

(a) SO $\Sigma_i\, m(0,2,3,4,5,6)$

b)



c)

7 gates + 11 inputs = 18

3x (4 and/or) + 2x(3 not) = 18

II) 1) $R_{ab} = \Big(\Big(\Big(\big((R_6 + R_2) \| R_5\big) + R_7\Big) \| R_4\Big) + R_1$

$R_{cd} = \Big(\Big(\Big(\big((R_4 + R_7) \| R_5\big) + R_2\Big) \| R_6\Big) + R_3 + R_8 + R_9$

2) $R_{left} = R_1 + R_2 + (R_3 \| R_4)$

$v_x = v_s \dfrac{R_1}{R_{left}}$

$v_w = -v_s \dfrac{R_3 \| R_4}{R_{left}}$

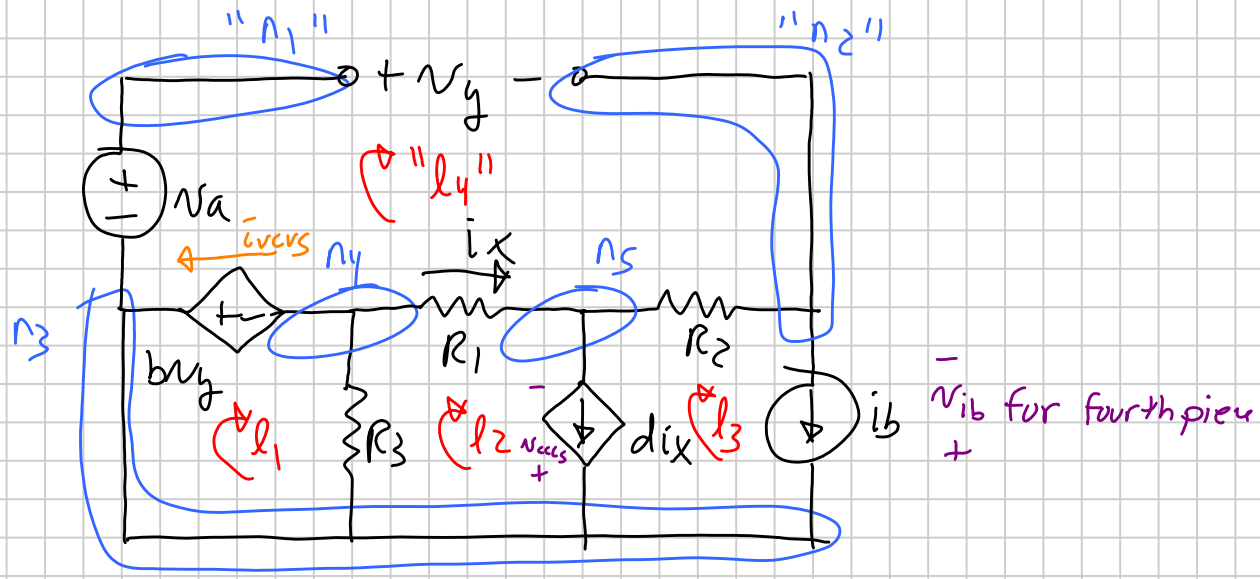
3) $R_{left} = R_1 + R_2 + (R_3 \| R_4)$

$i_y = -\dfrac{i_p R_5}{R_{left} + R_5}$ or $-i_p \dfrac{(R_5 \| R_{left})}{R_{left}}$

$i_2 = -i_y \dfrac{R_4}{R_3 + R_4}$ or $-i_y \dfrac{(R_3 \| R_4)}{R_3}$

So $i_2 = i_p \dfrac{R_5}{R_{left} + R_5} \dfrac{R_4}{R_3 + R_4} = i_p \dfrac{(R_5 \| R_{left})}{R_{left}} \dfrac{(R_3 \| R_4)}{R_3}$

III)



- KCL, sn$_{52}$: $-i_x + d i_x + i_b = 0$ $\quad i_x = \dfrac{i_b}{1-d}$

- KVL, l_4: $-v_a + v_y - R_2 i_b - R_1 i_x - b v_y = 0$

$$v_y = \frac{v_a + R_2 i_b + R_1 i_x}{1-b}$$

- $P_{abs,R_3} = \dfrac{v^2}{R_3} = (b v_y)^2 / R_3$

- P_{del,i_b} : KVL, sl$_{1234}$: $-v_a + v_y - v_{ib} = 0$ $\quad v_{ib} = v_y - v_a$

or KVL, sl$_{123}$: $b v_y + R_1 i_x + R_2 i_b - v_{ib} = 0$ $\quad v_{ib} = b v_y + R_1 i_x + R_2 i_b$

$$P_{del,i_b} = i_b v_{ib}$$

- $P_{del,cccs}$: KVL sl$_{12}$: $b v_y + R_1 i_x - v_{cccs} = 0$ $\quad v_{cccs} = b v_y + R_1 i_x$

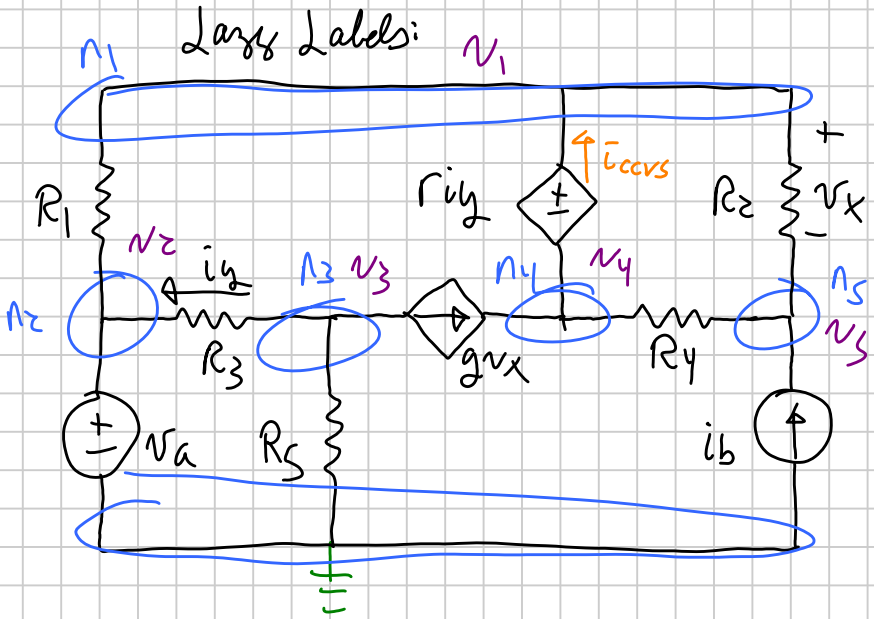
$$P_{del,cccs} = d i_x (b v_y + R_1 i_x)$$

- $P_{del,vcvs}$: KCL, n_4: $i_{vcvs} + \dfrac{(-b v_y)}{R_3} + i_x = 0$

$$i_{vcvs} = \frac{b v_y}{R_3} - i_x$$

$$P_{del,vcvs} = (b v_y)\left(\frac{b v_y}{R_3} - i_x\right)$$

IV



Unknowns:

v_1 v_2 v_3 v_4 v_5

v_x i_y

6 nodes − 1 − 2 v source = 3 KCL

KCL, n_3: $\frac{v_3 - v_2}{R_3} + \frac{v_3}{R_5} + gv_x = 0$

KCL, n_5: $\frac{v_5 - v_1}{R_2} + \frac{v_5 - v_4}{R_4} - i_b = 0$

KCL, Sn$_{1,4}$: $\frac{v_1 - v_2}{R_1} + \frac{v_1 - v_5}{R_2} - gv_x + \frac{v_4 - v_5}{R_4} = 0$

SRC v_a: $v_a = v_2$

SRC ccvs: $ri_y = v_1 - v_4$

MEAS v_x: $v_x = v_1 - v_5$

MEAS i_y: $i_y = \frac{v_3 - v_2}{R_3}$

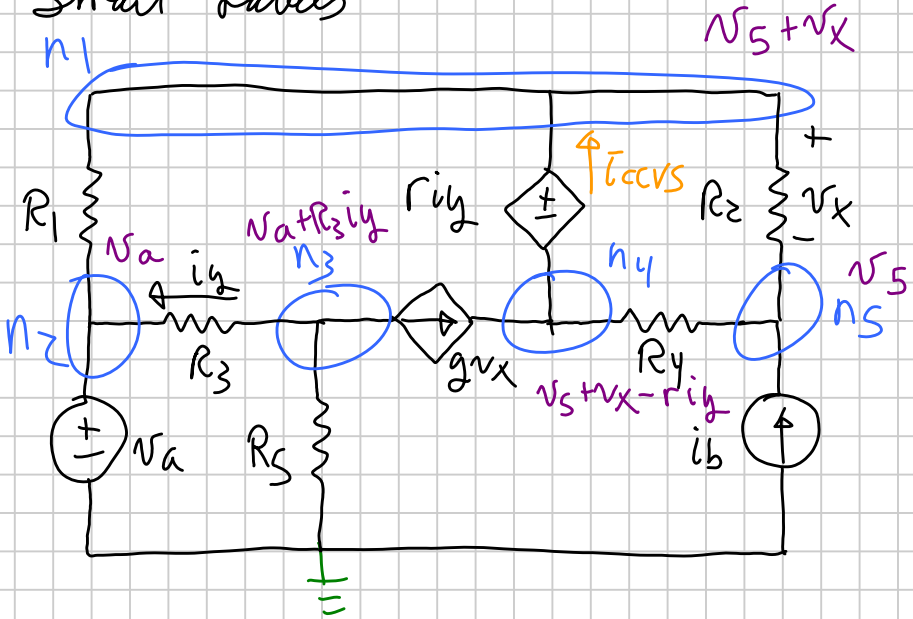
- $p_{abs,\ R_4} = (v_4 - v_5)^2 / R_4$
- $p_{del,\ vccs} = gv_x(v_4 - v_3)$
- $p_{del,\ ccvs}$: $ri_y i_{ccvs}$

  KCL, n_1: $-i_{ccvs} + \frac{v_1 - v_2}{R_1} + \frac{v_1 - v_5}{R_2} = 0$ $\quad i_{ccvs} = \frac{v_1 - v_2}{R_1} + \frac{v_1 - v_5}{R_2}$

or

  KCL, n_4: $i_{ccvs} - gv_x + \frac{v_4 - v_5}{R_4} = 0$ $\quad i_{ccvs} = gv_x - \left(\frac{v_4 - v_5}{R_4}\right)$

Smart labels



Unknowns: v_x, i_y, v_5

3 KCL still

KCL, n3: $i_y + \frac{(v_a + R_3 i_y)}{R_5} + g v_x = 0$

KCL, n5: $\frac{-v_x + r i_y}{R_4} - i_b - \frac{v_x}{R_2} = 0$

KCL, sn14: $\frac{v_5 + v_x - v_a}{R_1} - g v_x + \frac{v_x}{R_2} + \frac{v_x - r i_y}{R_4} = 0$

No need for SRC on MEAS; already used to label

- $P_{abs, R_4} = (v_x - r i_y)^2 / R_4$
- $P_{del, VCCS} = g v_x (v_5 + v_x - r i_y - v_a - R_3 i_y)$
- $P_{del, CCVS}$: $r i_y \, i_{CCVS}$

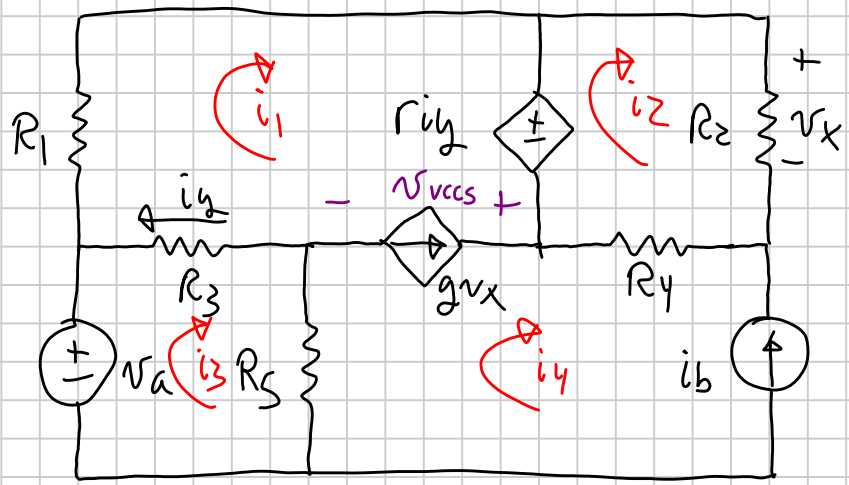
KCL, n1: $\frac{v_x + v_5 - v_a}{R_1} - i_{CCVS} + \frac{v_x}{R_2} = 0$

$i_{CCVS} = \frac{v_x + v_5 - v_a}{R_1} + \frac{v_x}{R_2}$

or KCL, n4: $-g v_x + i_{CCVS} + \frac{v_x - r i_y}{R_4} = 0$

$i_{CCVS} = g v_x - \left(\frac{v_x - r i_y}{R_4} \right)$

V) Mesh Current



4 mesh - 2 isource = 2 KVL

Unknowns. i_1 i_2 i_3 i_4 i_y v_x

KVL, l_2: $-ri_y + R_2 i_2 + R_4 (i_2 - i_4) = 0$

KVL, l_3: $-v_a + R_3 (i_3 - i_1) + R_5 (i_3 - i_4) = 0$

SRC, gv_x: $gv_x = i_4 - i_1$

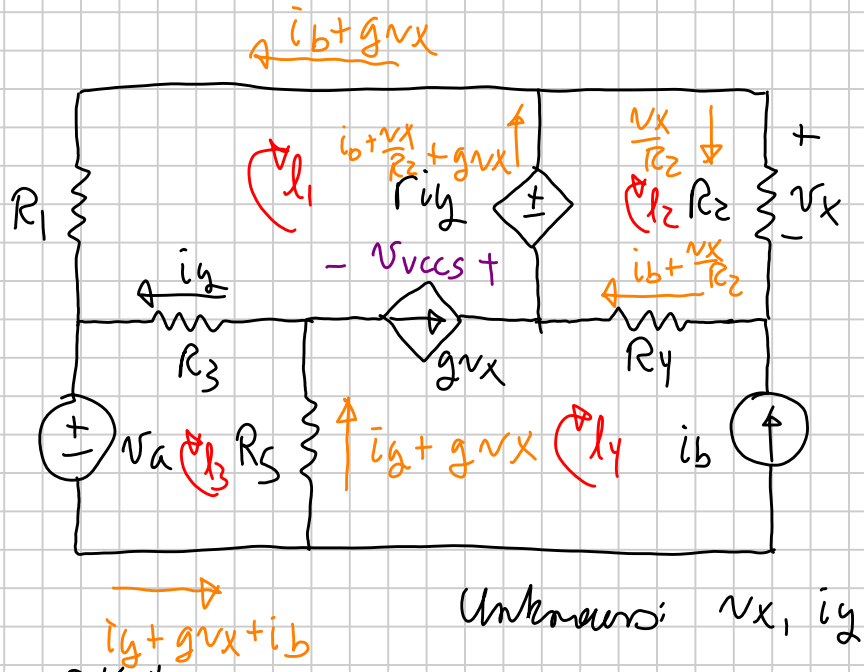
SRC, i_b: $i_b = -i_4$

MEAS, i_y: $i_y = i_1 - i_3$

MEAS, v_x: $v_x = R_2 i_2$

- $\phi_{abs,R_4} = (i_2 - i_4)^2 R_4$
- $\phi_{del,vccs} = gv_x v_{vccs}$ → KVL, l_1: $R_1 i_1 + ri_y + v_{vccs} + R_3 (i_1 - i_3) = 0$
  $v_{vccs} = -R_1 i_1 - ri_y - R_3 (i_1 - i_2)$
- $\phi_{del,ccvs} = ri_y (i_2 - i_1)$

Branch current



Unknowns: v_x, i_y

2 KVL:

KVL, I_2: $-r i_y + v_x + R_4 (i_b + v_x/R_2) = 0$

KVL, I_3: $-v_a - R_3 i_y - R_5 (i_y + g v_x) = 0$

- $p_{abs,\, R_4} = (i_b + v_x/R_2)^2 R_4$
- $p_{del,\, vccs} = g v_x v_{vccs}$

KVL, I_1: $-R_1 (i_b + g v_x) + r i_y + v_{vccs} + R_3 i_y = 0$

$v_{vccs} = R_1 (i_b + g v_x) - r i_y - R_3 i_y$

- $p_{del,\, ccvs} = r i_y (i_b + v_x/R_2 + g v_x)$