ECE112 - FINAL EXAM - W99

NAME: KEY

STUDENT ID# _____

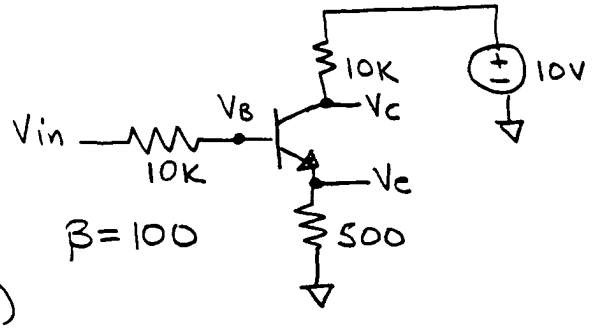
Check one box:

☐ Problems 7 and 8 are to be graded and are to replace my midterm exam.

☐ Only grade problems 1 – 6.

If neither box is checked, only problems 1 thru 6 will be graded and will count only as a final exam.

[12] 1. For the schematic below, a set of conditions are described. For the condition given, circle the correct region of operation.



(2 pts each)

a) $V_C = 10V$

b) $V_{CE} = 1.4V$, $I_C = \beta I_B$

c) $V_{BE} = -0.7V$, $V_{CE} = 10V$

d) $I_E \neq I_B(\beta+1)$, $V_{BE} = 0.7V$

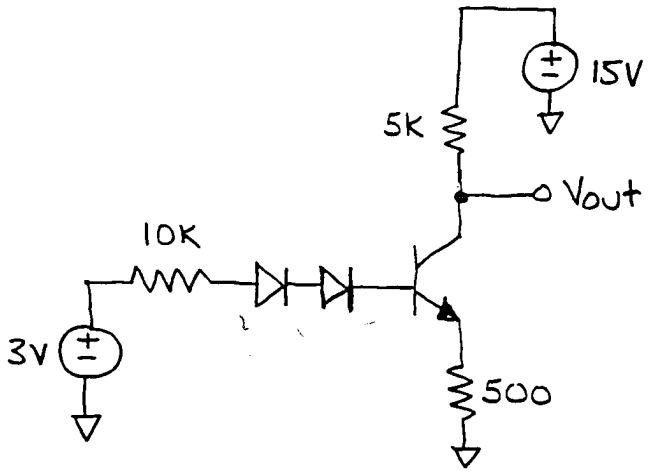
e) $I_B > \phi$, $V_E = 0.7V$, $V_C = 0.9V$

f) $I_B = 1\mu A$, $I_C = 100\mu A$

CIRCLE ONE		
(OFF)	SATURATED	ACTIVE FWD.
OFF	SATURATED	(ACTIVE FWD.)
(OFF)	SATURATED	ACTIVE FWD.
OFF	(SATURATED)	ACTIVE FWD.
OFF	(SATURATED)	ACTIVE FWD.
off	SATURATED	(ACTIVE FWD.)

[30] 2. For the circuit below Find:

[10] a) I_B
[2] b) I_c
[5] c) I_e
[3] d) V_c
[3] e) V_{out}
[5] F) V_{CE}
[2] g) Approximate gain of amplifier



- transistor beta (β) = 150
- diode drops (on) = 0.7 V
- transistor is in Active forward region of operation

$$-3 + 10000 I_B + 1.4 + 0.7 + (151)500 I_B = 0$$
$$85500 I_B = 0.9$$

a) $I_b = 10.53\,\mu A$

b) $I_c = 1.58\,mA$

c) $I_e = 1.59\,mA$

d) $V_E = I_E(500)$
$= .795V$

e) $V_{out} = 15 - I_c(5000)$
$= 7.1V$

f) $V_c - V_E = V_{CE} = 6.3V$

g) $gain \approx \frac{R_c}{R_e} = \frac{5000}{500} = 10$ or 9 (minus sign optional)

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[15] 3. Using the truth table below, do the following:

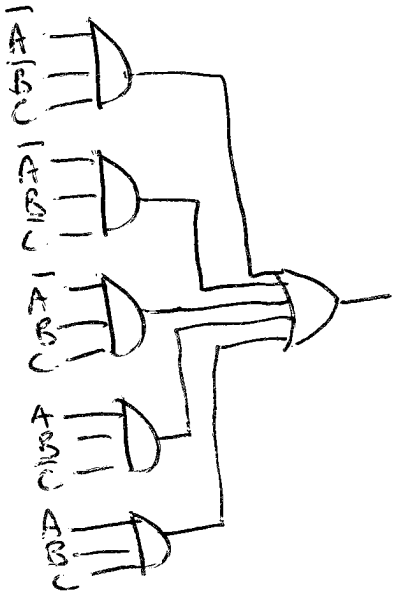
[5] a) draw the unminimized schematic diagram that implements the function given by the truth table.

[5] b) minimize the function with a K-MAP.

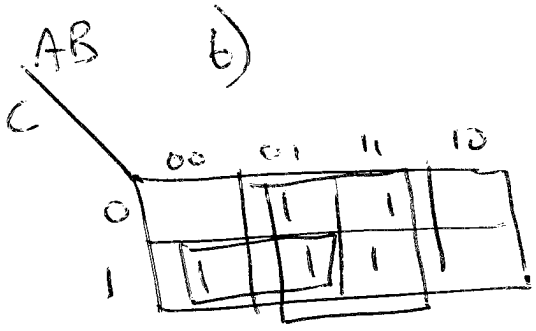
[5] c) draw the minimized schematic diagram.

A	B	C	Z
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

a)

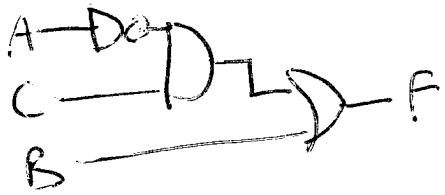


b)



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

c)



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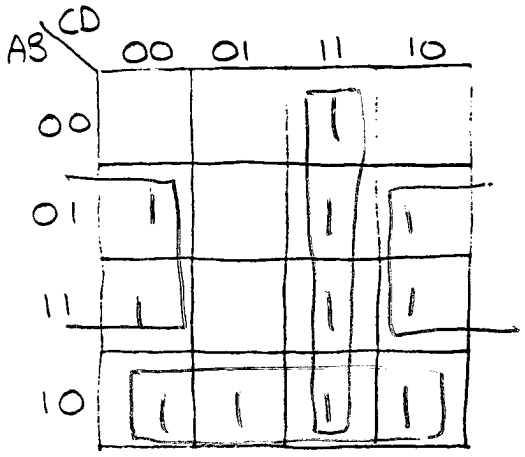
[8] 4. Give 4 reasons why minization of logic functions is important to the making of integrated circuits. You may not use cost as a reason.

a) die size
b) Power consumption
c) testing time
d) design time

+ use of resources
+ Reliability

[10] 5. Reduce the following boolean expression using a k-map.

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



REDUCED EXPRESSION IS:

$F = A\bar{B} + CD + B\bar{D}$

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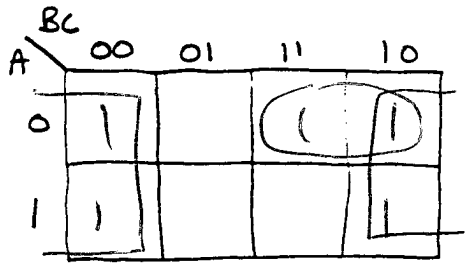
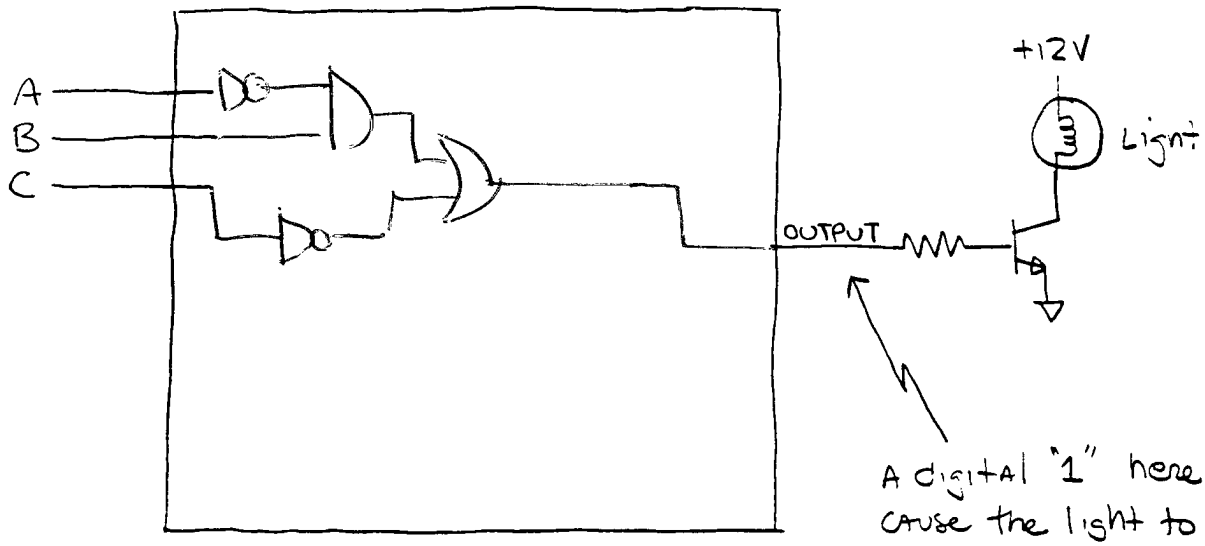
[25] 6. A digital system has three inputs labled A, B and C. They are binary representations of the decimal numbers 0 through 7. Design the digital logic necessary to illuminate a light that indicates if the input represents a number that is either even (zero is even) or is divisible by three. Show your K-MAP. Show your logic schematic.

$INPUT_{10}$	$INPUT_2$ A B C	OUTPUT
0	0 0 0	1
1	0 0 1	
2	0 1 0	1
3	0 1 1	1
4	1 0 0	1
5	1 0 1	
6	1 1 0	1
7	1 1 1	



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



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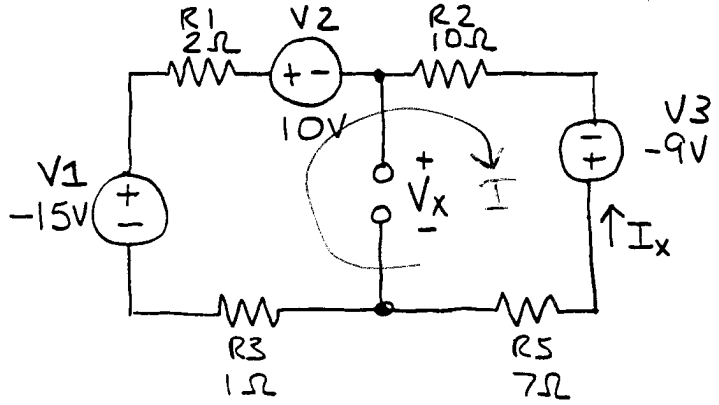
[40] 7. (OPTIONAL - MIDTERM REPLACEMENT PROBLEM)



For the circuit above, find
a) Ix
b) Vx
c) Power supplied by R5
d) Power generated by V3

$$15 + 2I + 10 + 10I + 9 + 8I = 0$$

$$20I = -34$$

$$I = -1.7A$$

a) $\boxed{I_x = 1.7A}$

b) $-V_x - 10 + 1.7(2) - 15 + 1.7 = 0$

$$-V_x = +19.9$$

$$\boxed{V_x = -19.9V}$$

c) $1.7(2)$

$= \boxed{-20.23W}$

d) $1.7(-9) = -15.3W$ diss. ✗

$= \boxed{15.3W \text{ gen.}}$ ✓

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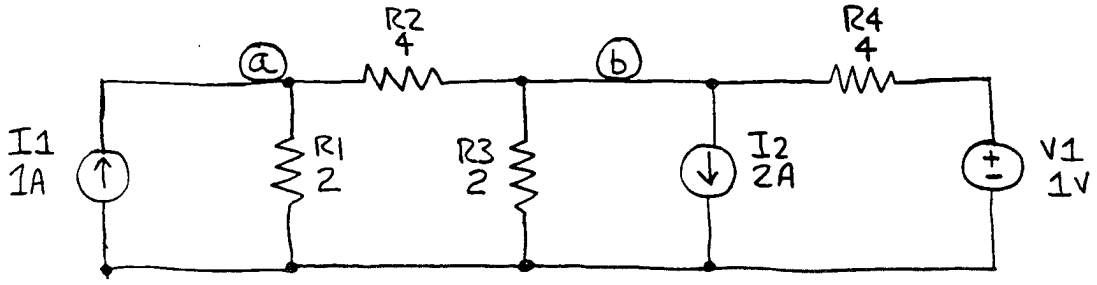
[60] 8. (OPTIONAL – MIDTERM REPLACEMENT PROBLEM)

For the circuit below, find:

a) Va
b) Vb
c) Power dissipated by 1A current source
d) Power dissipated by 1V voltage source



KVL @ X: $1 - I_1 - I_2 = 0$ +1 S

$1 - \frac{V_x}{2} - \frac{V_x - V_y}{4} = 0$ +10

$4 - 2V_x - V_x + V_y = 0$

$-3V_x + V_y = -4$ ①

@ Y: $I_2 - I_3 - 2 - I_4 = 0$ +1 S

$\frac{V_x - V_y}{4} - \frac{V_y}{2} - 2 - \frac{V_y - 1}{4} = 0$ +10

$V_x - V_y - 2V_y - 8 - V_y + 1 = 0$

$-4V_y + V_x = 7$ ②

$V_x = 7 + 4V_y$

Sub into ① $-3(7 + 4V_y) + V_y = -4$

$-21 - 12V_y + V_y = -4$

$-11V_y = 17$

$V_y = \frac{-17}{11}$

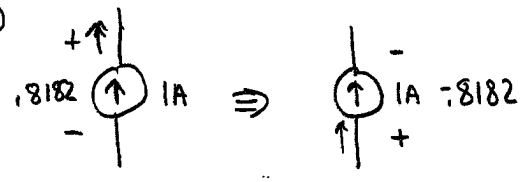
(b) $V_y = -1.545V$

$V_x = 7 + 4(-1.545)$

$7 + -6.182$

(a) $= .8182\,V$

(c)

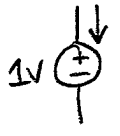


$P = IV = 1 * .8182$

$= .82W$ dissipated + S

(d) ? I_4 for $P = IV$

$I_4 = \frac{V_y - 1}{4} = \frac{-1.545 - 1}{4} = .6363$



$P = IV$ + S

$-.6363 * 1$

$= -.6363W$ dissipated