UNIVERSITY OF CALIFORNIA

College of Engineering
Department of Electrical Engineering
and Computer Sciences

NEAT SOLUTIONS

TO POST

Professor Oldham

Spring 2001

EECS 42 — MIDTERM #2

5 April 2001

Name: ______________________________
Last, First

Student ID: ____________

Signature: ______________________________

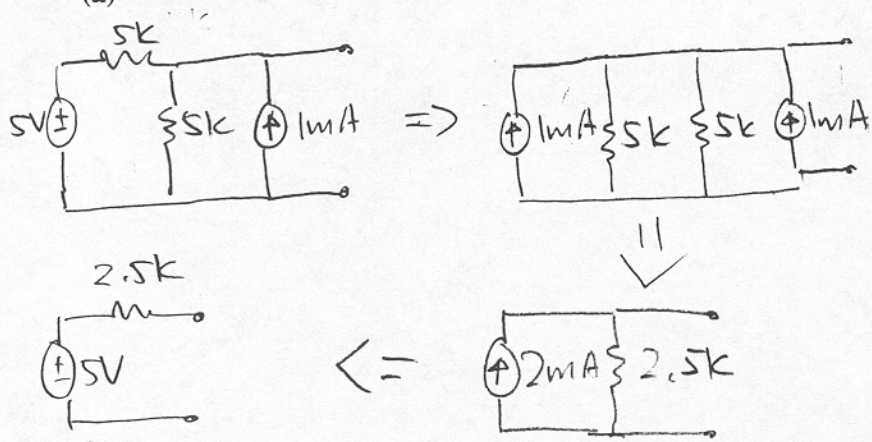
Guidelines:

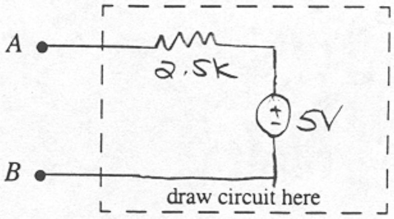
1. Closed book. A 3-page summary with formulas is provided at the end of the exam.
2. Show ***all your work and reasoning on the exam*** in order to receive credit.
3. **Warning**: Some problems will be graded with no partial credit, so check your answers.
4. You may use a calculator.
5. Do not unstaple the exam.
6. This exam contains 5 problems worth 20 points each, and corresponding worksheets plus the cover page and the 3-page summary with formulas.
7. **Please do not ask questions** except to point out possible errors or typographical mistakes.

Problem	**Points Possible**	**Your Score**
1	20	
2	20	
3	20	
4	20	
5	20	
Total	**100**	

Problem 1 Answer Sheet

(a)





R_T = 2.5K Ω

V_T = 5 V

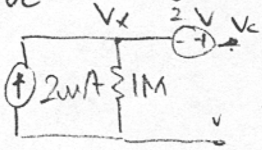
(b)

R_T : open 2mA short 2V

$R_T = 1M$

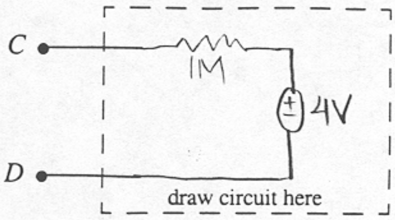
$V_T = V_{oc}$: all of 2uA flows through 1M res.

∴



$V_x = 2uA \times 1M = 2V$

$V_c = 2V + 2 = 4V$

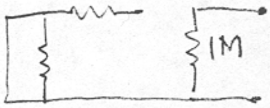


R_T = 1M Ω

V_T = 4 V

(c)

R_T : open 1uA and short 2V

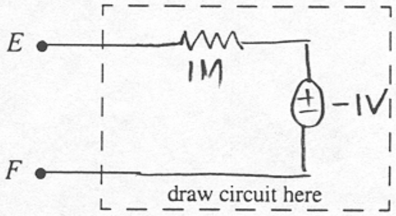


only sees 1M

$R_T = 1M$

$V_T = V_{oc}$: all of 1uA flows through 1M

$$\therefore \frac{V_F - V_E}{1M} = 1uA \Rightarrow V_{EF} = -1uA \times 1M$$
$$= -1V$$

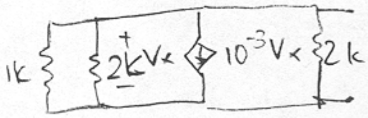


R_T = 1M Ω

V_T = -1 V

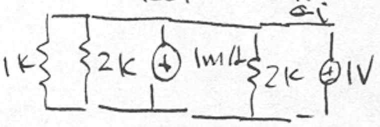
(d)

R_T: open 2V KEEP DEPENDENT CURRENT SOURCE THERE!



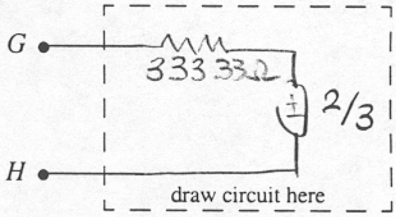
Apply test charge of 1V and find i $R_T = V/i$

$V_{TEST} = 1 \Rightarrow V_x = 1$



$i - 1mA - \frac{1}{500} = 0$ $i = 3mA$

$R_T = 1/3mA = 333.33\Omega$



R_T = 333.33 Ω

V_T = 2/3 V

$V_T = V_{oc} = V_x$: write nodal equation to find V_x

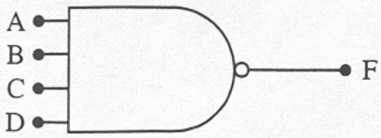
$$(2-V_x)/1K + -V_x/2K - 10^{-3}V_x - V_x/2K = 0 \Rightarrow V_x = \frac{2}{3}V$$

Problem 2 (20 points)

As you know, sometimes two quite different circuits are equivalent. Consider the five following circuits. Indicate by circling which circuits are equivalent to each other.

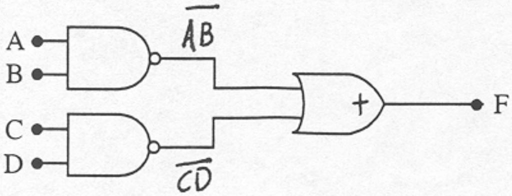
NOTE: Do not guess; you MUST actually demonstrate that the circuits are equivalent. If you do not show the basis for your assertions of equivalence, you cannot receive credit. (Please do not ask a question of how to demonstrate equivalence–you are responsible for knowing that.) The grading will reward for correct answers with appropriate basis for the choices and will subtract for wrong answers.

(a)



$F = \overline{ABCD}$

(b)

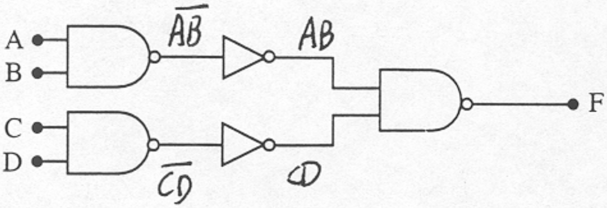


$F = \overline{AB} + \overline{CD}$

$= \bar{A} + \bar{B} + \bar{C} + \bar{D}$ DeMorgan's rule

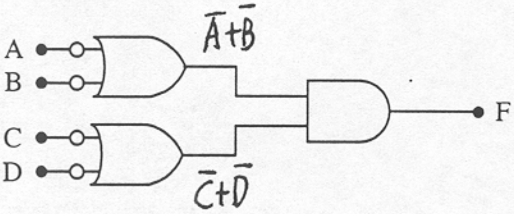
$= \overline{ABCD}$ DeMorgan's rule

(c)



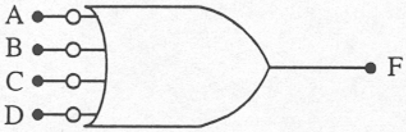
$= \overline{ABCD}$

(d)



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

(e)



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

$= \overline{ABCD}$ DeMorgan's rule

Problem 2 Worksheet

This problem actually ~~has~~ not to done by truth table. As shown, by applying DeMorgan's, we can find that a. b, c, e are equivalent. To test if d is equivalent to the other four. We can try one (or two) test assignments (counterexamples).

A	B	C	D	$\overline{ABCD}$	$(\bar{A}+\bar{B})(\bar{C}+\bar{D})$
0	0	1	1	1	0

So, only a, b, c, e are equivalent

However, since most people used truth tables, I will also show full truth table comparison for d and other four.

				(d)	(a,b,c,e)
A	B	C	D	$(\bar{A}+\bar{B})(\bar{C}+\bar{D})$	$\overline{ABCD}$
0	0	0	0	1	1
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	1
0	1	0	0	1	1
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	1
1	0	0	0	1	1
1	0	0	1	1	1
1	0	1	0	0	1
1	0	1	1	0	1
1	1	0	0	0	1
1	1	0	1	0	1
1	1	1	0	0	1
1	1	1	1	0	0
				0 when A,B are both 1, or C,D are both 1.	only 0 when A,B,C,D are all 0.

Problem 3 Answer- and Worksheet

(a)

A	B	C	W	X	Y	Z	F	
0	0	0	1	1	1	0	0	
0	0	1	1	0	1	1	1	← $\bar{A}\bar{B}C$
0	1	0	1	0	0	1	0	
0	1	1	1	0	0	1	0	
1	0	0	1	1	1	0	0	
1	0	1	1	0	1	1	1	← $A\bar{B}C$
1	1	0	0	0	0	1	0	
1	1	1	0	0	0	1	0	

SEE LECT 17 & 18 ~~NOTES~~ KEY IDEAS OR TEXT BOOK

(b)

FROM TRUTH TABLE:

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

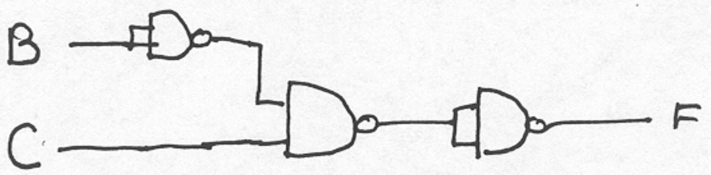
BUT $\bar{A}(\bar{B}C) + A(\bar{B}C) = (\underset{\substack{\uparrow \\ 1}}{A+\bar{A}})\ \bar{B}C$

(c)

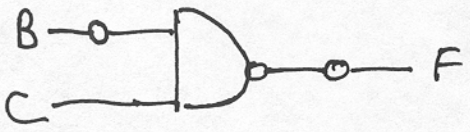
F = $\bar{B}C$

(d)

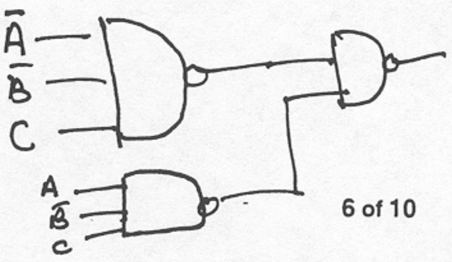
BEST ✓



(OR)

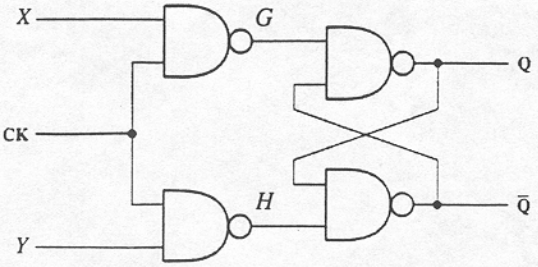


OR, IF UNSIMPLIFIED:



Problem 4 (20 points)

(a) Consider the circuit below:



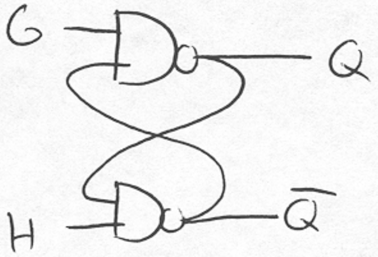
		NAND
0	0	1
0	1	1
1	0	1
1	1	0

Fill in the value for Q in the timing diagram opposite. But to show your work, you must also show values for G and H. Note that the initial value of Q is 0, as shown by heavy dark line on the timing diagram. Ignore stage delay.

Find G by looking at X and CK , G = X NAND CK
Find H by looking at Y and CK , H = Y NAND CK

Find Q by analyzing the right two flip flops. It is similar to an SR Flip Flop

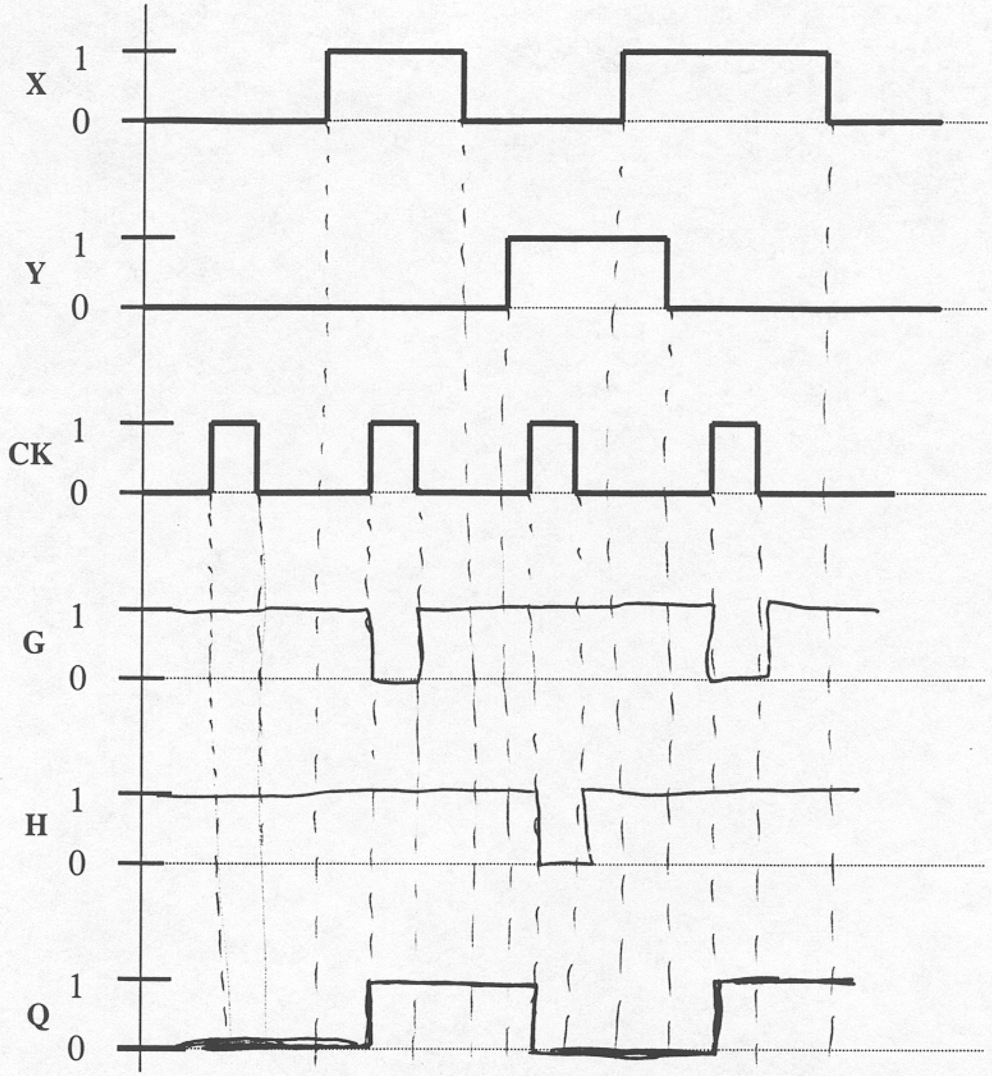
(b) For the same circuit, fill in the table, opposite.



(not G) \ G = set
(not H) \ H = reset
G = H = 1 ; Hold

Problem 4 Answer Sheet

(a)

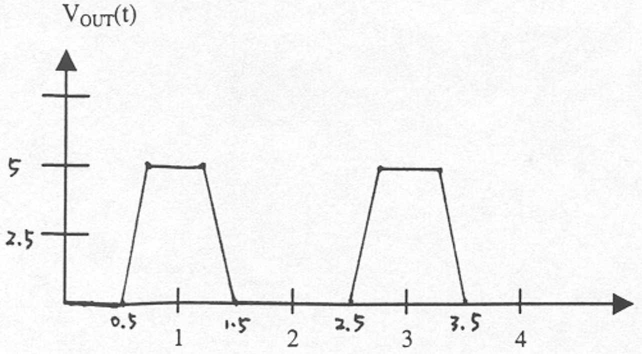


(b) The table below is intended to show the value of Q after CK goes high. Fill in the "**Q**" column with **0** or **1** or "$\mathbf{Q_{old}}$".

X	Y	Q (after CK=1)
0	0	Q_{old}
0	1	0
1	0	1

Problem 5 Worksheet and Answersheet

(a)



(a). In the linear Range, Vout = 5 Vin

But high rail is 5 V and Low rail is 0 V. So for Vout,

$$V_{out} = \begin{cases} 5\,V, & (5\,V_{in} > 5) \\ 5\,V_{in} & (0 < V_{in} < 1) \\ 0 & (V_{in} < 0) \end{cases}$$

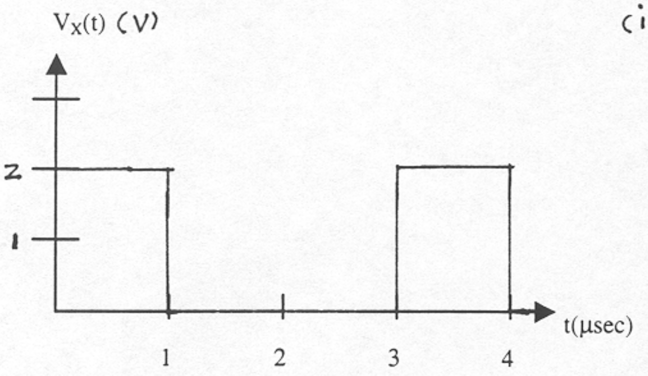
(b). Since Vin (t<0) is not clearly specified. We give full credit for next two cases: either Vin = 0 for t<0 or Vin = 2 for t<0;

Vx follows Vin, but limited by the high/Low rail;

Vout will show transient because of the RC circuit.

$\tau = R \cdot C = 0.5\ \mu sec.$

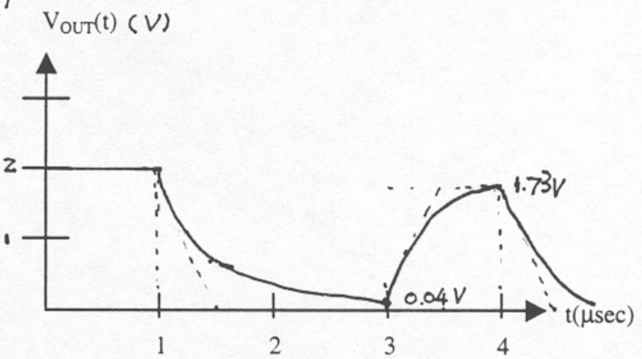
(b)



(i) Vin = 2V for t < 0

(ii) Vin = 0V for t < 0

(i)



(ii)