EEL3701 – Dr. Gugel
Fall 2017
Exam #1

Last Name, First Name KEY

UF ID#

*Open book and open notes, **90-minute** examination.* ***No electronic devices are permitted.***

Page 1)	8 points	Alex	Page 2)	24 points	#8, #9 Tomasz / #5-7 Aamir
Page 3)	18 points	Angela	Page 4)	18 points	#12 Matt / #14 Ben
Page 5)	17 points	Gabe	Page 6)	16 points	#18 Cody / #19 Kyle

TOTAL ______________ of 101 Casey, Cody, Juan, Kyle

Re-grade requests must be handed in the day exams are returned in class. *Write the problem number you wish reviewed.* ***A maximum of three review problems is allowed.*** *Do not write anywhere else on the exam other than below or you will receive a zero on the exam.*

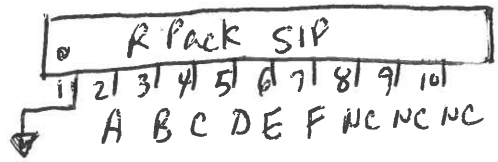
1. Problem No. Casey & Juan
2. Problem No. remove staples, scan, restaple & sum } Thank you Aamir
3. Problem No. ______________

1. Given a **16 bit Signed Hex** number, **FAB4**, what is it equivalent to in decimal? Note: You may express your answer as a sum of powers of 16. i.e. $5 \times 16^5 + 2 \times 16^1 + \dots$ (2 pt.)

1111 1010 1011 0100 → 0000 0101 0100 1100

1111 1010 1011 0011 (-1) FAB4 $= -(5\times16^2 + 4\times16^1 + 12)$

2. A student would like to use their **SIP (Single Inline Package) R-Pack** from lab as a group of **pull down** resistors for inputs A, B, C, D, E and F. Draw the device below and show/label all pins & connections. (2 pt.)



NC = no connect

3. A student would like to add (6) **8 bit Unsigned** numbers. How many bits are required in the final answer such that no carry is generated and the final sum is correct? Hint: Solve for a smaller word length. (2 pt.)

$N=3$ 111_2 → 101010
$6*7=42$ $N=6$
$=32+8+2$ 3 extra

256 * 6 ~ 1500 10 bits 1024-1
8bits 256-1 11 bits 2048-1
9 bits 512-1

$\boxed{11 \text{ Bits}}$

4. When subtracting (3) **10 bit Signed** numbers (A – B – C), how many bits are required in the final answer such that no overflow will occur? Hint: Solve for a smaller word length. (2 pt.)

$N=3$ $A=-4=100_2$ → 10110 $N=5$
$B=C=3$ 2 extra bits
$-4-3-3=-10$

$\boxed{12 \text{ bits}}$

Pg. Score =

5 – 7. Perform the following addition, subtraction and multiplication as required below. (7 pt.)

KEY

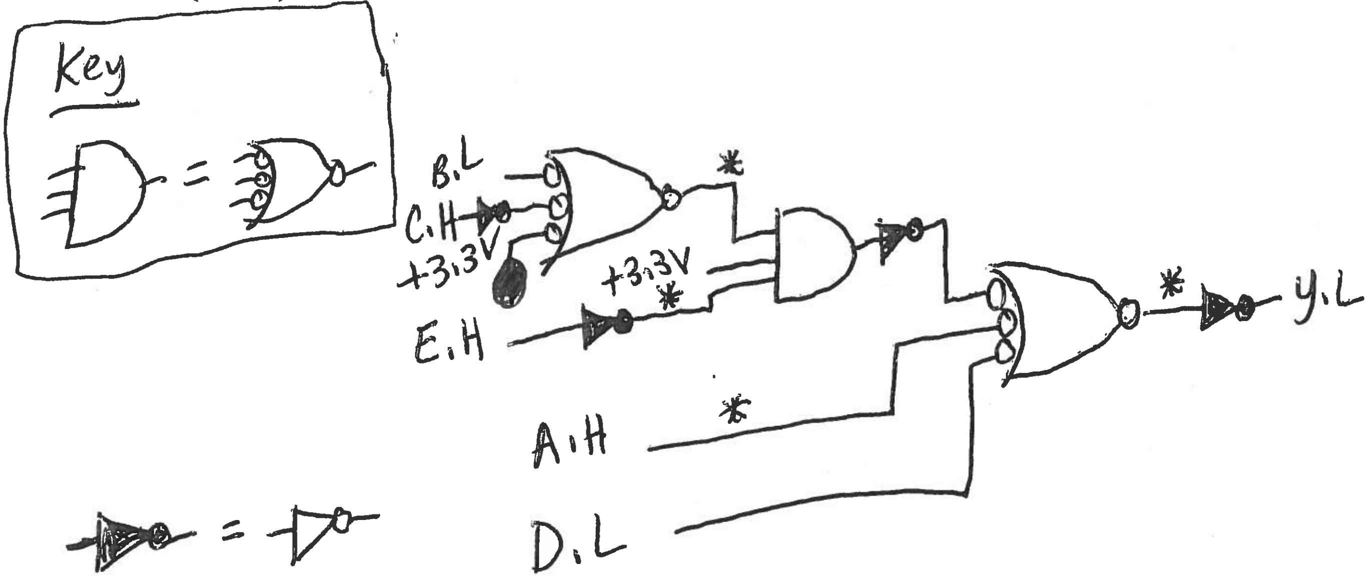
1 1
1 0 1 0 1 1
111111
101101
+010111
$\boxed{10000011}$

0 2 0 2 0 2
1 1 0 1 1 0 1 0 1
\- 0 1 1 1 0 1 0 1 1
$\boxed{11001010}$

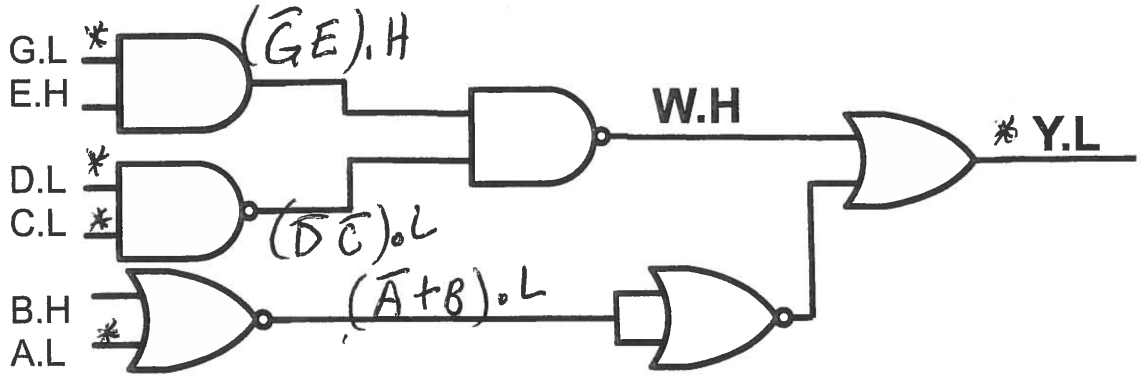
10111.101
x 1001.01
101.11101
10111.10100
101111101.00000
Sum
$\boxed{11011010.10001}$

8. Directly synthesize a circuit ~~for the following equation~~ using only ***3 Input AND gates*** and ***Inverters***. (9 pt.)

$Y = \overline{\overline{A} + \overline{(B+C)} * \overline{E} + D}$; A.H, B.L, C.H, D.L, E.H, Y.L **Do Not Simplify the Equation!**



9. Derive the logic equations for the following signals listed after the circuit below. ***Show all intermediate signals as HIGH true for partial credit purposes. DO NOT SIMPLIFY YOUR ANSWER!***



W.H = $\overline{(\overline{G}E)(\overline{\overline{D}\,\overline{C}})}$ (5 pt.)

Y.L = $\overline{W + \overline{A} + B}$ (3 pt.)

Page Score =

10. Find the **minimum sum of products** and **minimum product of sums** for the logic equation below using a K-Map

$$\overline{A}BC + AB\overline{C}\overline{D} + A\overline{B}\overline{C} + B\overline{C}D + \overline{A}\overline{C}\overline{D}$$

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

Y (MSOP) = $\overline{A}B + \overline{C}\overline{D} + A\overline{C}$ (6)

Y (MPOS) = $(\overline{A}+\overline{C})(B+\overline{C})(A+B+\overline{D})$ (4)

11. Simplify the logic equation from #10 above using Boolean Identities. Show all your steps for full credit. You don't have to specify which Boolean Identity you are using but do have to show all intermediate steps. (8 pt.)

$AB\overline{C}\overline{D} + A\overline{B}\overline{C}$

$A\overline{C}(B\overline{D}+\overline{B})$

$A\overline{C}(\overline{D}+\overline{B})$

$A\overline{C}\overline{D} + A\overline{B}\overline{C}$

$A\overline{C}\overline{D} + \overline{A}\overline{C}\overline{D}$

$\overline{C}\overline{D}(A+\overline{A})$

$\boxed{\overline{C}\overline{D}}$

$\overline{A}BC + B\overline{C}D$

$\overline{A}BD$

$A\overline{C}\overline{D} + B\overline{C}D$

$AB\overline{C}$

$A\overline{C}(\overline{B}+B) = \boxed{A\overline{C}}$

$B\overline{C}D + \overline{A}\overline{C}\overline{D}$

$\overline{A}B\overline{C}$

Now OR with

$\overline{A}B\overline{C} + \overline{A}BC = \boxed{\overline{A}B}$

Page Score =

KEY

12. Simplify the equation below with **De Morgan's Rule** and **Boolean Identities** to find the **MSOP**. (10 pt.)

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

$$\overline{\bar{A}+\bar{C}} + \overline{A+B} + \overline{\bar{B}+D+E} + \overline{B+\bar{C}} + \overline{B+D+E} + \bar{A}+\bar{B}+D+E$$

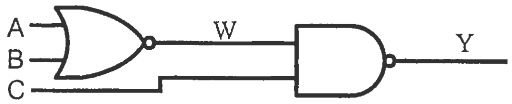
$$AC + \bar{A}\bar{B} + \underbrace{B\bar{D}\bar{E} + \bar{B}C + \bar{B}\bar{D}\bar{E}}_{\bar{D}\bar{E}} + AB\bar{D}\bar{E}$$

$$AC + \bar{A}\bar{B} + \bar{D}\bar{E} + \boxed{\bar{B}C}$$

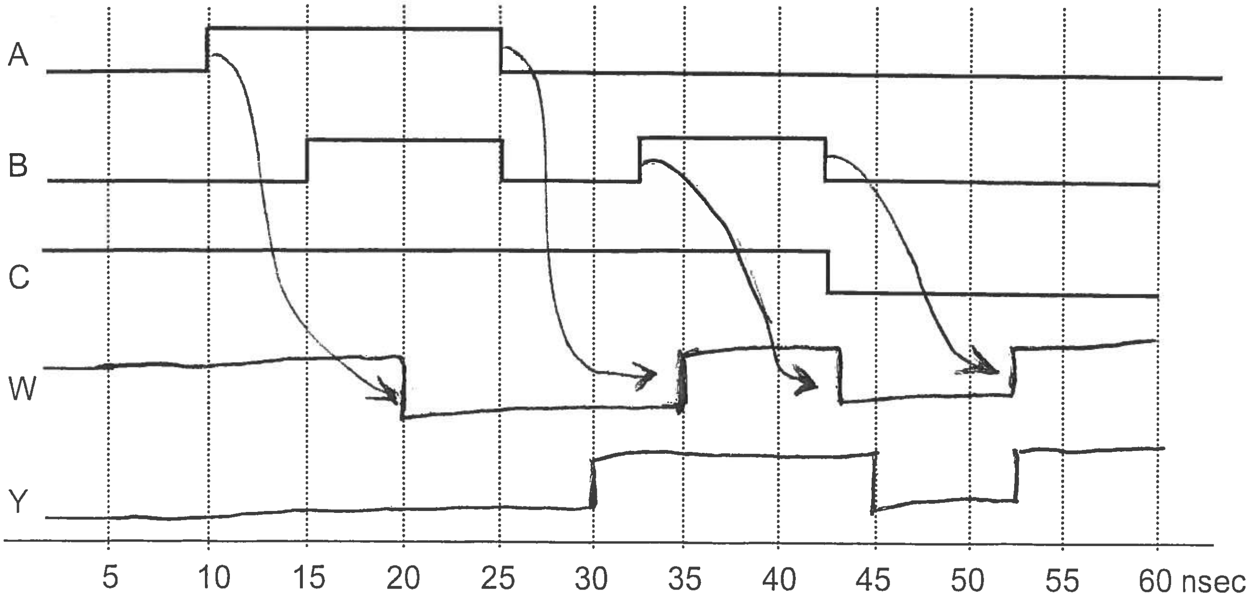
$$AC + \bar{A}\bar{B}$$
$$= AC + \bar{A}\bar{B} + \bar{B}C$$

Y = $AC + \bar{A}\bar{B} + \bar{D}\bar{E}$ **MSOP**

14. Given the circuit below complete the voltage timing diagram for signals X and Y. Assume all devices have a **10 nsec** propagation delay. (8 pt.) **Assume A = B = Y = L, C = W = H initially.**



Gate Propagation Delay is 10nsec!



#15

A1:0	B2:0	A=B	A>B	A<B
00	000	1	0	0
01	001	1	0	0
10	110	1	0	0
11	111	1	0	0
00	1--	0	1	0
01	000	0	1	0
01	1--	0	1	0
10	10-	0	1	0
11	10-	0	1	0
11	110	0	1	0
00	001	0	0	1
00	01-	0	0	1
01	01-	0	0	1
10	0--	0	0	1
10	111	0	0	1
11	0--	0	0	1

Can be combined for 0X1XX

1X 10X

4 combinations
2points

14 combinations
5points

14 combinations
5 points

In the order you wanted

A1:0	B2:0	A=B	A>B	A<B
00	000	1	0	0
00	001	0	0	1
00	01-	0	0	1
00	1--	0	1	0
01	000	0	1	0
01	001	1	0	0
01	01-	0	0	1
01	1--	0	1	0
10	0--	0	0	1
10	10-	0	1	0
10	110	1	0	0
10	111	0	0	1
11	0--	0	0	1
11	10-	0	1	0
11	110	0	1	0
11	111	1	0	0

In case of negrades that were done in this manner.

MSOP:

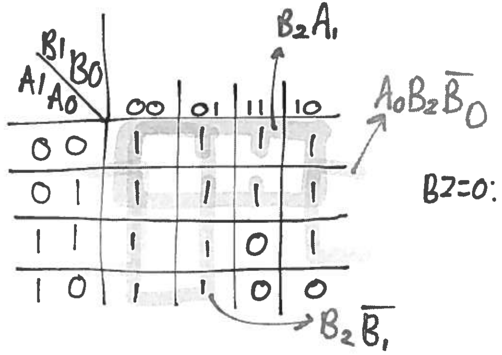
$A>B = \overline{A1}B2 + \overline{A1}A0\overline{B1}\,\overline{B0} + A0B2\overline{B0} + B2\overline{B1}$

~~$A<B = A1\overline{A0}B1B0 + A1\overline{B2} + \overline{A0}\,\overline{B2}\,\overline{B0} + \overline{B2}B1$~~ not a question/answer

$A=B = A1A0B2B1B0 + A1\overline{A0}B2B1\overline{B0} + \overline{A1}A0\overline{B2}\,\overline{B1}B0 + \overline{A1}\,\overline{A0}\,\overline{B2}\,\overline{B1}\,\overline{B0}$ cannot be simplified

work

B2=1



A1A0 \ B1B0	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	0	1
10	1	1	0	0

$B_2\overline{A_1}$

$A_0B_2\overline{B_0}$

$B_2\overline{B_1}$

B2=0: only - $\overline{A_1}A_0\overline{B_2}\,\overline{B_1}\,\overline{B_0}$

0	X	1	X	X
0	1	0	0	0
1	X	1	0	X
1	1	1	1	0

$\overline{A_1}B_2$

$\overline{A_1}A_0\overline{B_2}\,\overline{B_1}\,\overline{B_0}$

$A_1B_2\overline{B_1}$

$A_1A_0B_2B_1\overline{B_0}$

[redacted]

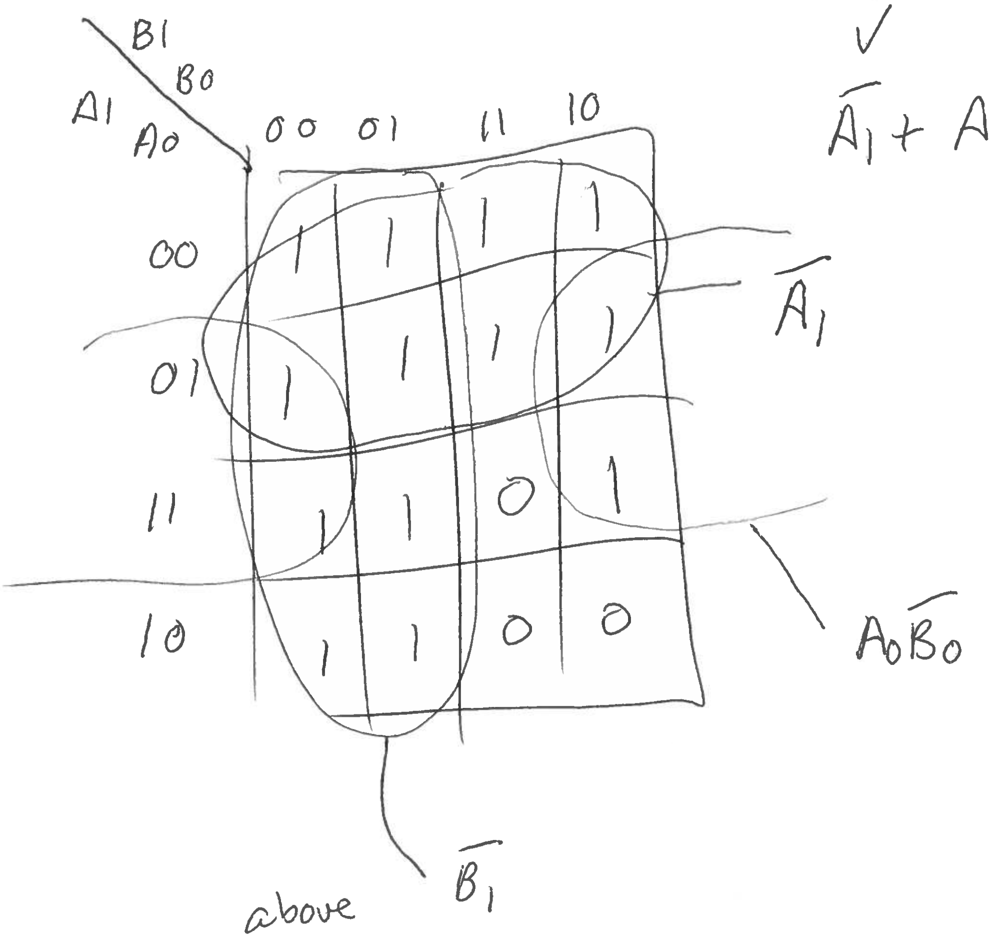
$\overline{A_1}A_0\cancel{\overline{B_2}}\,\overline{B_1}\,\overline{B_0} + A_0B_2\overline{B_0} + B_2\overline{A_1} + B_2\overline{B_1}$

MSOP: $\overline{A_1}A_0\overline{B_1}\,\overline{B_0} + A_0B_2\overline{B_0} + B_2\overline{A_1} + B_2\overline{B_1}$

$B_2(\overline{A_1} + A_1\overline{B_1} + A_1A_0B_1\overline{B_0})$

$+ \overline{B_2}(\overline{A_1}A_0\overline{B_1}\,\overline{B_0})$

$B_2 = 1$



A1A0 \ B1B0	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	0	1
10	1	1	0	0

✓ ✓ ✓ ✓

$\overline{A_1} + A_1\overline{B_1} + A_1A_0B_1\overline{B_0}$

$$= B_2\overbrace{\left(\overline{A_1} + \overline{B_1} + A_0\overline{B_0}\right)}^{\text{above}} + \overline{B_2}\left(\overline{A_1}A_0\overline{B_1}\,\overline{B_0}\right)$$

$$= \overline{A_1}B_2 + \underbrace{\overline{B_1}B_2 + A_0\overline{B_0}B_2 + \overline{A_1}}_{}A_0\overline{B_2}\,\overline{B_1}\,\overline{B_0}$$

$\overline{B_1}\left(B_2 + \overline{A_1}A_0\overline{B_2}\,\overline{B_0}\right)$

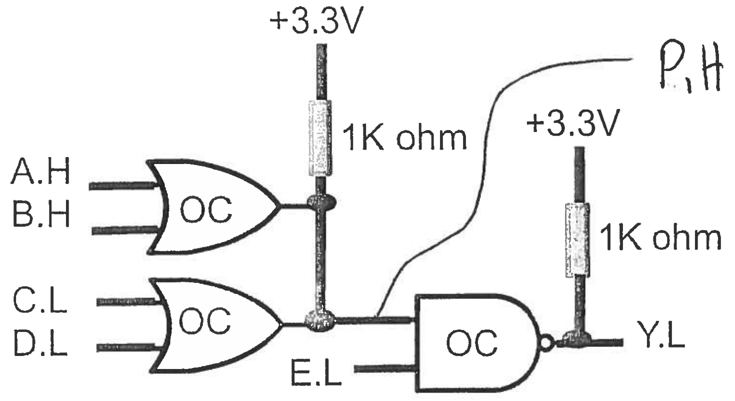
$\overline{B_1}\left(B_2 + \overline{A_1}A_0\overline{B_0}\right)$

$$= \overline{A_1}B_2 + B_2\overline{B_1} + A_0B_2\overline{B_0} + \overline{A_1}A_0\overline{B_1}\,\overline{B_0}$$

Final Answer!

Tough Problem!

18. For the circuit below, derive the **MSOP logic equation** for **Y.L**. ***Note: Simplify as a Sum of Products!*** (4 pt.)



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

Pull out $\bar{E}$

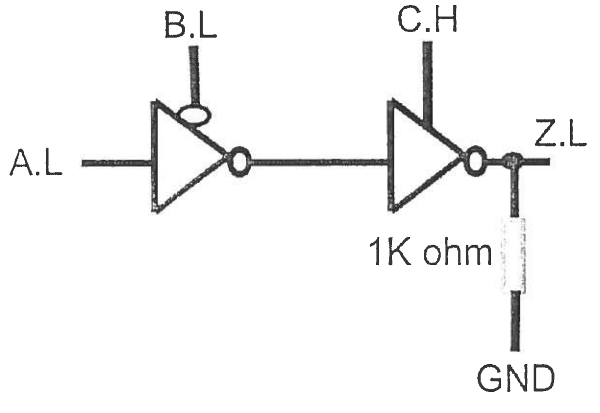
$(A\bar{C} + A\bar{D} + B\bar{C} + B\bar{D})\bar{E}$

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

Same as above

Y.L = $(A+B)(\bar{C}+\bar{D})\bar{E} = A\bar{C}\bar{E} + A\bar{D}\bar{E} + B\bar{C}\bar{E} + B\bar{D}\bar{E}$ **MSOP**

19. For the circuit below, derive the **MSOP logic expression** for **Z.L** **Simplify as a Min. Sum of Products!** (4 pt.)



$Z = ABC + \bar{C} = AB + \bar{C}$

Z.L = $AB+\bar{C}$ however if B=F AND C=T then Z = unknown **MSOP**

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