

UNCC – ECGR2181- Midterm Exam 1 – October 9, 2009

A Name: SOLUTION Mosaic User ID _____

Question	1-15	16	17	18	19	20	21	22	Total
Score	/60	/10	/10	/10	/20	/10	/10	/20	/150

Please read and sign this statement: I have not received from anyone nor assisted others while taking this test. I have also notified the test proctor of any of these violations noted above.

Signature: _____

16) Convert the following. Circle your final answer. (15 points)

a. 11011001_2 to decimal (5 points)

(*Note: assume signed byte is a 2's complement value)

$$\begin{array}{cccc} \underline{11} & \underline{011} & \underline{001} & \\ -2^7 & +2^6 & +2^4 & +2^3 & +2^0 \end{array}$$

$$\begin{array}{r} -128 \\ +64 \\ +16 \\ +8 \\ +1 \\ \hline = \boxed{-39_{10}} \end{array}$$

b. Sign extend the binary number in Part A to 16-bits (2 points)

$$\boxed{1111111111011001_2}$$

-2 points if sign extended with all 0s

c. Convert 16-bit binary number from Part B to hexadecimal (3 points)

$$\begin{array}{cccc} \underline{1111} & \underline{1111} & \underline{1101} & \underline{1001} \\ \downarrow & \downarrow & \downarrow & \\ F & F & D & 9 \end{array}$$

1 point for Fs
1 point for D
1 point for 9

$$\boxed{0xFFD9}$$

17) Give the minterm list for the following truth table: (10 points)

a	b	c	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

$$\bar{a}\bar{b}c$$

$$\bar{a}b\bar{c}$$

$$a\bar{b}c$$

$$abc$$

$$f(a,b,c) = \bar{a}\bar{b}c + \bar{a}b\bar{c} + a\bar{b}c + abc$$

2 points per term

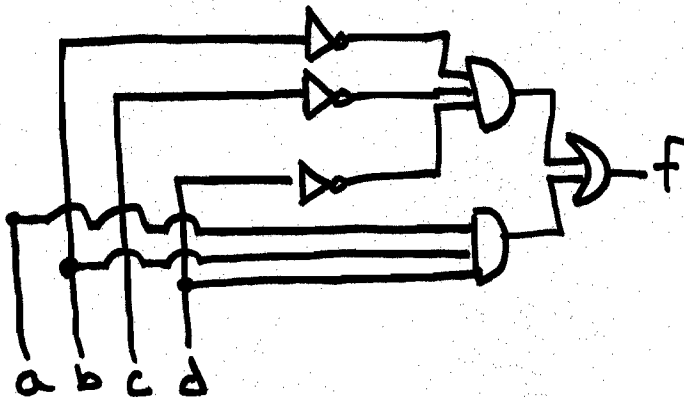
2 points for correctness

18) Draw the circuit using the fewest number of gates. Use only basic logic gates (AND, OR, Inv.). Also, the circuit should use the fewest number of gates and the fewest number of inputs to the gates. Fully label all inputs and outputs. (10 points)

$$F(a,b,c,d) = \sum m(0, 8, 13, 15)$$

$$f = \bar{b}\bar{c}\bar{d} + abd$$

- 3. Inverters
- 2. Ands
- 1. Or



Not required to implement with NAND

	ab				
	00	01	11	10	
cd	00	01	11	10	
00	1	0	0	1	
01	0	0	1	0	
11	0	0	1	0	
10	0	0	0	0	

19) Using **Boolean algebra** reduce the following expression to its minimal sum of product (SOP) form. List all of the Boolean algebra properties used. (20 points)

$$F(a,b,c,d) = (a'+c)' \cdot ((b'+a \cdot d) \cdot (a \cdot c \cdot d'))'$$

$$\begin{aligned}
 f(a,b,c,d) &= (a'+c)' \cdot ((b'+a \cdot d) \cdot (a \cdot c \cdot d'))' \\
 &= (a \cdot c') \cdot ((b'+a \cdot d)' + (a \cdot c \cdot d'))' \\
 &= (a \cdot c') \cdot (b \cdot (a \cdot d)' + (a' + c' + d)) \\
 &= (a \cdot c') \cdot (b \cdot (a'+d') + (a' + c' + d)) \\
 &= (a \cdot c') \cdot (a' \cdot b + b \cdot d' + a' + c' + d) \\
 &= (a \cdot c') \cdot (a' \cdot (b+1) + b \cdot d' + c' + d) \\
 &= (a \cdot c') \cdot (a' + b \cdot d' + c' + d) \\
 &= \underline{a} \underline{a}' c' + a b c' d' + \underline{a} \underline{c}' c' + a c' d \\
 &= 0 + a b c' d' + a c' + d \\
 &= a c' (b d' + 1 + d)
 \end{aligned}$$

- 1) DeMorgan's Law x 2
- 2) DeMorgan's Law x 2
- 3) DeMorgan's Law
- 4) Distributive
- 5) Distributive
- 6) Null, ID Laws
 $b+1=1$
- 7) Distributive
- 8) Complement
Idempotent Law
- 8) ID, Distributive
- 9) Null Law

$$f(a,b,c,d) = ac'$$

20) Simplify the following equation using Karnaugh Maps. (10 points)

$$F(a,b,c,d) = \sum m(0, 3, 4, 5, 8, 10, 11, 12, 13)$$

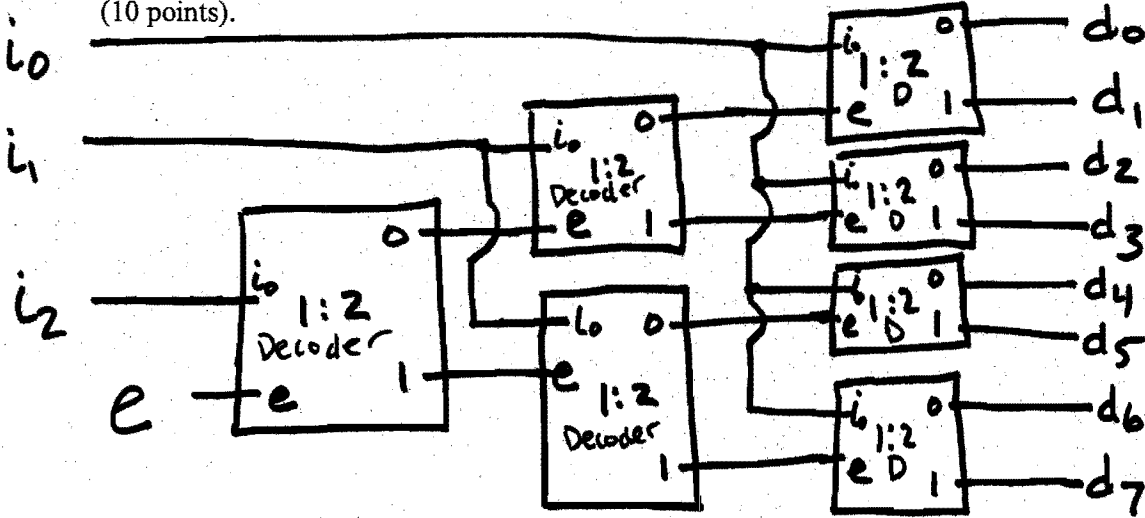
	ab				
cd	00	01	11	10	
00	0	1	1	1	
01	1	0	1	0	
11	1	0	0	1	
10	0	0	0	1	

$$f = b\bar{c} + \bar{c}\bar{d} + \bar{b}cd + a\bar{b}c$$

2 points for kmap

2 points per term in F

21) Design a 3 to 8 decoder using only 1 to 2 decoders. Use as many as you need. Fully label all inputs and outputs. (10 points).



22) Design a 13x1 multiplexer (with one enable bit) using only 4x1 and 2x1 multiplexers. Use as many as you need. Fully label all inputs and outputs and select lines. (20 points)

