Computer Engineering 111
Test 1
February 11, 2000

Name _____

Nine problems, 100 points.

Closed books, closed notes, no calculators. You would be wise to read all problems before beginning, note point values and difficulty of problems, and budget your time accordingly.

Please do not open the test until I tell you to do so.

Good luck!

1. (5 points) $F = A(\overline{B} + (AC \oplus D))$

Rewrite F in minimal SOP form. Show your work! (Hint: It works to use a K-map but using the relations of Boolean algebra is much quicker.

(minimal SOP) F =

2. (12 points) Redraw this circuit in NAND – NAND representation. For full credit, the best solution uses 8 NAND gates, but any correct answer will get partial credit.
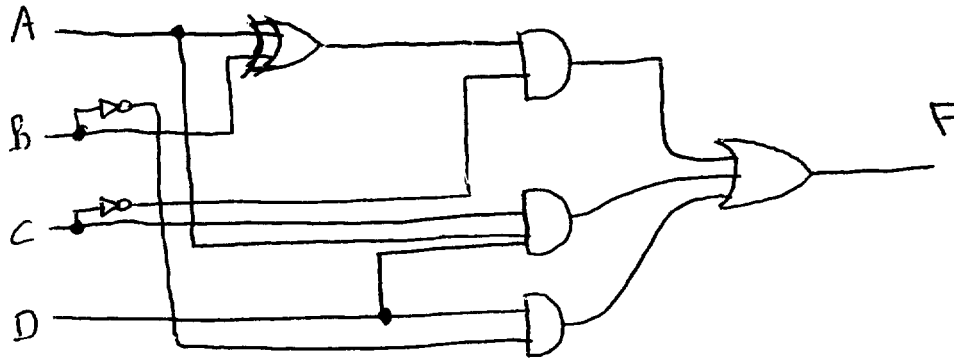
3. (11 total points)

a) (2 points) convert to hex and binary:

47023 (octal)   =   (binary) =   (hex)

b) (2 points) convert to decimal:

1011011101 (binary)   =   (decimal)

c) (5 points) convert to binary, octal and hex:

896.78125 (decimal)   =   (binary)

896.78125 (decimal)   =   (octal)

896.78125 (decimal)   =   (hex)

d) (2 points) convert to octal and hex

100100101011.11100101 (binary)   =   (octal)   =   (hex)

4. (20 points) Find a minimal SOP implementation of F as given in the truth table below. Use your choice of methods, but show your work.

Decimal	ABCDE	F	F(E)
0	00000	0	
1	00001	1	
2	00010	1	
3	00011	0	
4	00100	0	
5	00101	1	
6	00110	0	
7	00111	0	
8	01000	0	
9	01001	1	
10	01010	1	
11	01011	1	
12	01100	0	
13	01101	0	
14	01110	0	
15	01111	1	
16	10000	0	
17	10001	1	
18	10010	1	
19	10011	0	
20	10100	0	
21	10101	1	
22	10110	0	
23	10111	0	
24	11000	0	
25	11001	0	
26	11010	1	
27	11011	1	
28	11100	0	
29	11101	0	
30	11110	0	
31	11111	0	

AB CD
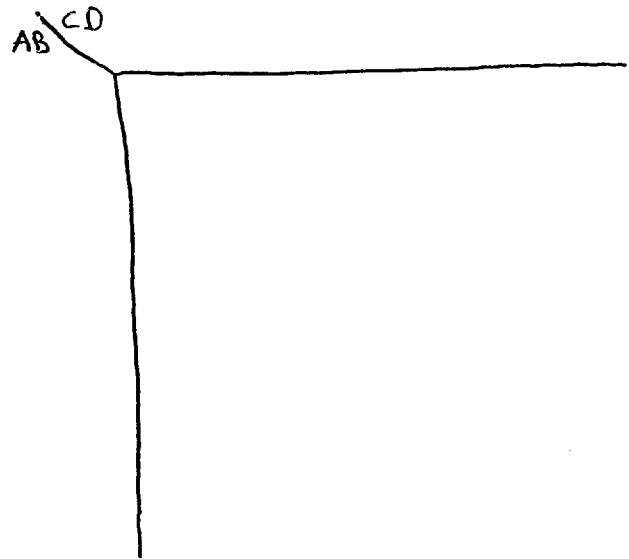
5. (17 points)

Al has class 8:30 – 9:30 MWF and 2:00 – 3:30 TTh

Bob has class 12:00 – 1:30 and 2:00 – 3:30 TTh

Cathy has class 8:30 – 9:30 MWF and 12:00 – 1:30 TTh

$D = 0$ if today is T or Th, and $D = 1$ if today is MW or F.

$A = 0$ if Al skips all classes today, and $A = 1$ if Al attends all classes today

$B = 0$ if Bob skips all classes today, and $B = 1$ if Bob attends all classes today

$C = 0$ if Cathy skips all classes today, and $C = 1$ if Cathy attends all classes today

$F = 0$ if no two of Al, Bob, and Cathy are in class at the same time today, and

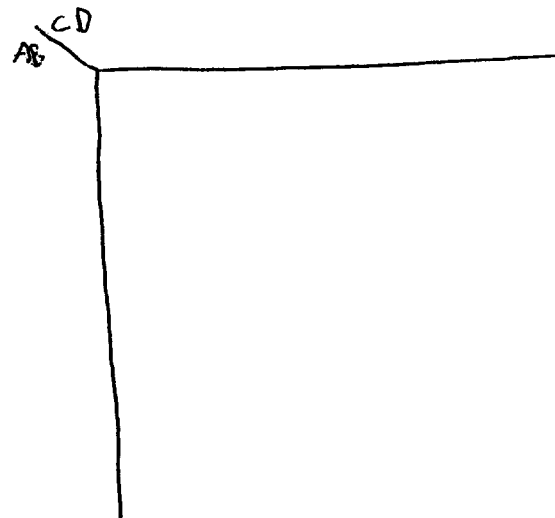$F = 1$ if any two of Al, Bob, and Cathy are in class at the same time today.

Write F in terms of minterms, and again in maxterms, i.e.:

$F = \Sigma m($)

$F = \Pi M($)

Find the minimal SOP expression for F.

| Decimal	ABCD	F
0	0000	
1	0001	
2	0010	
3	0011	
4	0100	
5	0101	
6	0110	
7	0111	
8	1000	
9	1001	
10	1010	
11	1011	
12	1100	
13	1101	
14	1110	
15	1111	

Would your logic be simplified if Cathy **never** skips classes on MWF? If so, give the simplified expression. If not, say why not.

6. (9 points)

$$F = \prod M(1,4,5,9,12,14,15)$$

Write the <u>canonical</u> POS expression and the <u>minimal</u> SOP expression for F.

Decimal	ABCD	F
0	0000	
1	0001	
2	0010	
3	0011	
4	0100	
5	0101	
6	0110	
7	0111	
8	1000	
9	1001	
10	1010	
11	1011	
12	1100	
13	1101	
14	1110	
15	1111	

AB CD
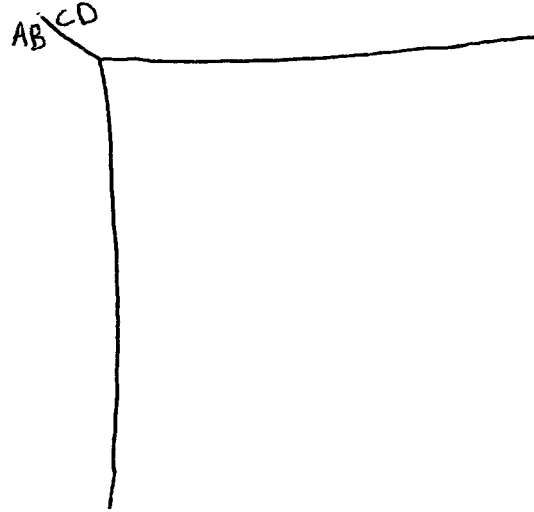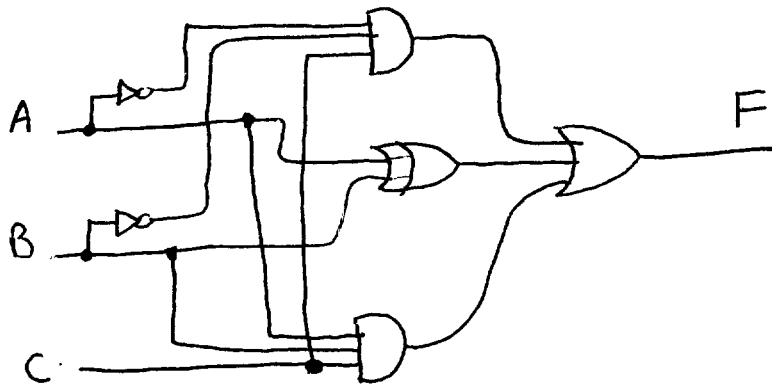
7. (9 points)
Re-implement the diagram shown with exactly:

a)   Two 2-input AND gates
      Two inverters
      One 3-input OR gate

b)   One XOR gate
      One 2-input OR gate

Show your work and sketch your solutions on both parts!
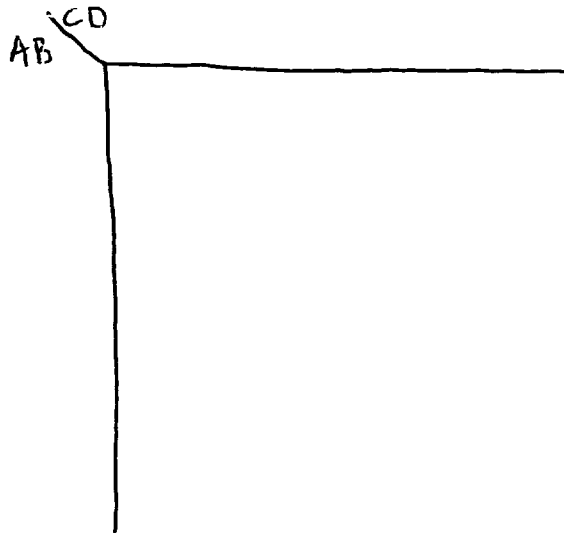
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ABC  F
000
001
010
011
100
101
110
111
```

8. (9 points) F is given by the truth table below. Express F in minimal SOP form, and as a sum of minterms, i.e. $F = \Sigma m($).

SOP Form: $F =$

Decimal	ABCD	F
0	0000	0
1	0001	1
2	0010	1
3	0011	0
4	0100	1
5	0101	1
6	0110	1
7	0111	1
8	1000	0
9	1001	1
10	1010	0
11	1011	0
12	1100	1
13	1101	0
14	1110	1
15	1111	1

CD

AB

9. (8 points) Your input is a BCD signal and your output is:

$$
F = \begin{cases} 1 & \text{if the input is a valid currency in US dollars, i.e. \$1, \$2, \$5} \\ 0 & \text{otherwise} \end{cases}
$$

Find the minimal SOP form.

Decimal	ABCD	F
0	0000	
1	0001	
2	0010	
3	0011	
4	0100	
5	0101	
6	0110	
7	0111	
8	1000	
9	1001	
10	1010	
11	1011	
12	1100	
13	1101	
14	1110	
15	1111	