JOINT INSTITUTE
交大密西根学院

Ve270 Introduction to Logic Design

Homework 1

Assigned: May 14, 2020

Due: May 21, 2020, 2:00pm.

A pop quiz will be given on the due date.

1. Fill out the blank spaces, assuming unsigned numbers. Show steps to earn partial credits. (8 points)

   11011101.001_{2} = __221.125__$_{10}$ = __DD.2__$_{16}$

   63.89_{10} = __111111.1110__$_{2}$ = __77.7__$_{8}$ = __2100.220__$_{3}$

2. Fill out the blank spaces, assuming 2's complement numbers. (16 points)

   -71_{10} = __10111001__$_{2}$ = __B9__$_{16}$

   71_{10} = __01000111__$_{2}$ = __47__$_{16}$

   10110101101_{2} = __-595__$_{10}$

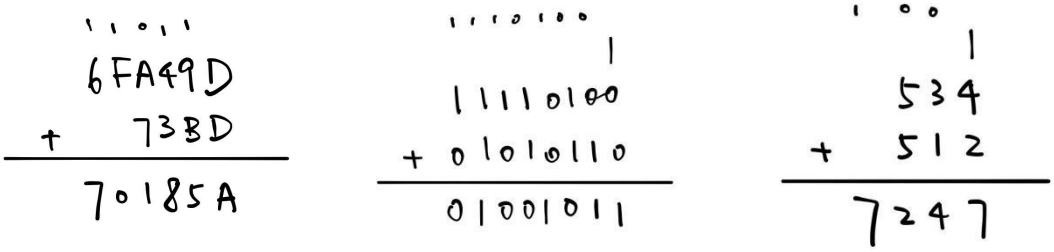
   $FBA9_{16}$= __1111 1011 1010 1001__$_{2}$ = __-1111__$_{10}$

3. Perform the following arithmetic operations step by step, assuming 2's complement numbers: (12 points)

   $(6FA49D + 73BD)_{16} = 70185A_{16}$ no overflow.

   $(10100 - 10101001)_{2} = 01001011_{2}$ no overflow.

   $(534 - 265)_{8} = 7247_{8}$ with overflow. (247_{8} with overflow is also acceptable).



4. Problem 2.14 (Boolean equation = logic equation) (4 points)

2.14 Evaluate the Boolean equation F = a AND (b OR (c AND d)) for the given values of variables a, b, c, and d:

a. a=1, b=1, c=0, d=1

b. a=0, b=0, c=0, d=1

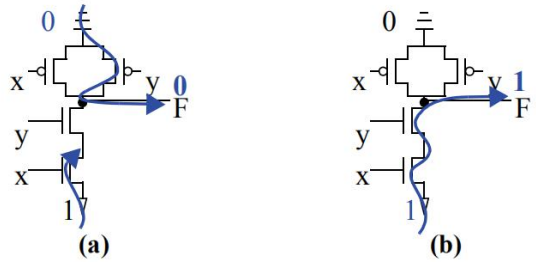
c. a=1, b=0, c=0, d=0

d. a=1, b=0, c=1, d=1

a) F = 1 AND (1 OR (0 AND 1)) = 1 AND (1 OR 0) = 1 AND 1 = 1
b) F = 0 AND (0 OR (0 AND 1)) = 0 AND (0 OR 0) = 0 AND 0 = 0
c) F = 1 AND (0 OR (0 AND 0)) = 1 AND (0 OR 0) = 1 AND 0 = 0
d) F = 1 AND (0 OR (1 AND 1)) = 1 AND (0 OR 1) = 1 AND 1 = 1

5. Problem 2.16 (10 points)

2.16 Show the conduction paths and output value of the AND gate transistor circuit in Figure 2.14 when: (a) x = 1 and y = 0, (b) x = 1 and y = 1.



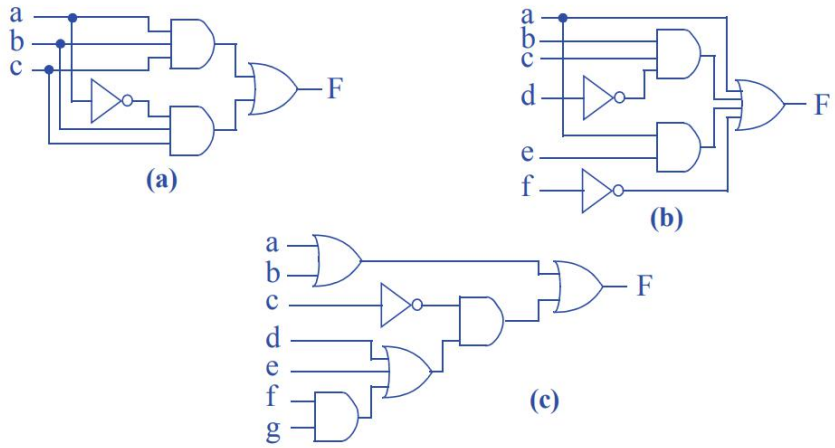
6. Problem 2.19 (10 points)

2.19 Convert each of the following equations directly to gate-level circuits:

a. F = abc + a′bc

b. F = a + bcd′ + ae + f′

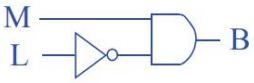
c. F = (a + b) + (c′ * (d + e + fg))



7. Problem 2.20 (10 points)

2.20 Design a system that sounds a buzzer inside a home whenever motion outside is detected at night. Assume a motion sensor has an output M that indicates whether motion is detected (M=1 means motion detected) and a light sensor with output L that indicates if light is detected (L=1 means light is detected). The buzzer inside the home has a single input B that when 1 sounds the buzzer. Capture the desired system behavior using an equation, and then convert the equation to a circuit using AND, OR, and NOT gates.

B = M * L'



8. Problem 2.35 (10 points)

2.35 Convert each of the following Boolean equations to a truth table:

a. F(a,b,c) = a' + bc'
b. F(a,b,c) = (ab)' + ac' + bc
c. F(a,b,c) = ab + ac + ab'c' + c'
d. F(a,b,c,d) = a'bc + d'

Inputs			Outputs
a	b	c	F
0	0	0	1
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	0

(a)

Inputs			Outputs
a	b	c	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

(b)

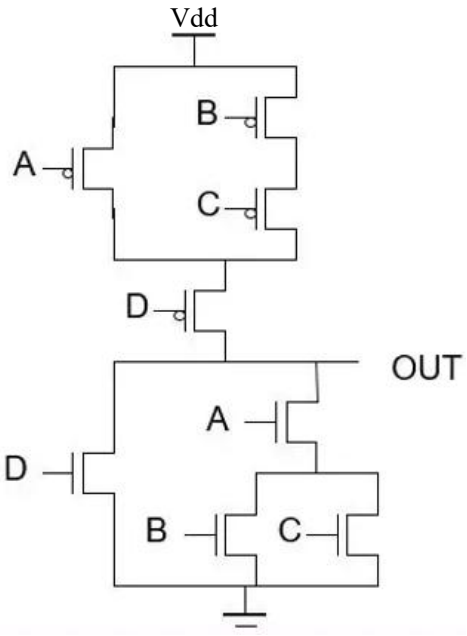
Inputs			Outputs
a	b	c	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

(c)

Inputs				Outputs
a	b	c	d	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

(d)

9. Build a truth table for the following circuit. (10 points)



$out = D' \cdot (A' + B' \cdot C')$

(optional)

A	B	C	D	out
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

10. Given a logic equation F = a'bc' + b'c + abc, draw an output waveform for F based on the given input waveforms. (10 points)