Dr. S. Shirani **COE2DI4 Midterm Test #1** Oct. 14, *2010*

Instructions: This examination paper includes 9 pages and 20 multiple-choice questions starting on page 3. You are responsible for ensuring that your copy of the paper is complete. Bring any discrepancy to the attention of your invigilator. The answers for all the questions must be indicated by filling the corresponding circle on the optical scanning (OMR) examination sheet. **This OMR examination sheet is the only page to be handed in.** The instructions for completing the OMR examination sheet are provided on page 2. Read and follow these instructions with care! There is one mark for each question. Answer all questions. There is no penalty for guessing. This is a closed book exam. No reference material of any kind is permitted. No calculators of any kind are permitted. **Time allowed is 50 minutes**.

Note: A' and $\overline{A}$ are used interchangeably.

OMR examination instructions

Multiple choice questions (numbered 1 to 20) – indicate your answer by filling the corresponding circle on the OMR answer sheet

1. The binary representation of $(-13)_{10}$ with 8 bits in 2's complement format is:

1. $(1000\ 0010)_2$
2. $(1000\ 1111)_2$
3. $(1111\ 1111)_2$
4. $(1111\ 0011)_2$
5. $(1111\ 0010)_2$

2. The hexadecimal equivalent of the unsigned number $(252)_{10}$ is:

1. $(F12)_{16}$
2. $(FB)_{16}$
3. $(FC)_{16}$
4. $(FA)_{16}$
5. $(FD)_{16}$

3. The range of numbers that can be represented with 7 bits in 1's complement format is:

1. $(-63)_{10}$ to $(64)_{10}$
2. $(-63)_{10}$ to $(63)_{10}$
3. $(-64)_{10}$ to $(64)_{10}$
4. $(-64)_{10}$ to $(63)_{10}$
5. none of the above

4. The binary equivalent of the unsigned number $(23.75)_{10}$ is:

1. $(0010\ 0101.\ 0111\ 0101)_2$
2. $(10101.11)_2$
3. $(10111.01)_2$
4. $(10101.10)_2$
5. $(10111.11)_2$

5. The hexadecimal equivalent of 176_8 is:

1. 72_{16}
2. 75_{16}
3. $7E_{16}$
4. $8E_{16}$
5. $7F_{16}$

6. A system has one output F and four inputs where the first two inputs A and B represent one 2-bit unsigned binary number, and the second two inputs C and D represent another 2-bit unsigned binary number. F is to be 1 if and only if the sum of the two numbers is odd. The minimal POS form of F:

1. Has 2 sum terms
2. Has 3 sum terms
3. Has 4 sum terms
4. Has 5 sum terms
5. None of the above

7. Let's assume AB+B'D' is the simplified form of F(A,B,C,D)=A'B'C'D'+AB'D'+ABC'. What is the minimum number of required don't cares with four literals:

1. 3
2. 2
3. 4
4. 5
5. 6

8. If y+z=0 then xy'+xz'+xw' is equal to:

1. xw
2. x+w
3. x
4. 0
5. none of the above

9. The simplest SOP form of function G(a,b,c,d,)=Σm(3,4,5,7,9,13,14,15) is

1. G(a,b,c,d)=bd+a'bc'+a'cd+abc+ac'd
2. G(a,b,c,d)=a'cd+a'bc'+ac'd+abc
3. G(a,b,c,d)=bd+a'b'cd+a'bc'd'+ab'c'd+abcd'
4. G(a,b,c,d)= cd+ab+c'd+a'b
5. None of the above

10. Assuming that f(w,x,y,z)=wxy'+y'z+w'yz'+x'yz' and g(w,x,y,z)=(w+x+y'+z')(x'+y'+z)(w'+y+z'). What is the simplified form of h(w,x,y,z)=f(w,x,y,z).g(w,x,y,z)?

1. h(w,x,y,z)=wxy'z'+w'y'z+x'yz'
2. h(w,x,y,z)=wxy'z'+wy'z
3. h(w,x,y,z)=w'y'z+x'yz'+wy'z'
4. h(w,x,y,z)=wxy'z'+w'yz+wy'z
5. none of the above

11. What statement is correct for $f(A,B)$ in the following circuit?

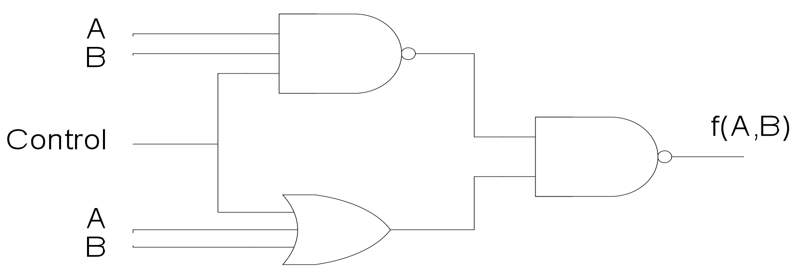

Figure 1: Circuit for question 11

1. $f(A,B) = A + B$ when Control = 0
2. $f(A,B) = \overline{\overline{A.B}.(A+B)}$ when Control =1
3. $f(A,B) = A.B$ when Control =0
4. $f(A,B) = \overline{A} + \overline{B}$ when Control =1
5. $f(A,B) = \overline{A}.\overline{B}$ when Control =0

12. Consider the function $f(x_1, x_2, x_3) = x_1.x_2.x_3 + \overline{x}_1.\overline{x}_2.\overline{x}_3 + \overline{x}_1.x_2.\overline{x}_3 + \overline{x}_1.x_2.x_3$, what is the POS for this function?

1. $f(x_1, x_2, x_3) = (x_1 + x_2 + x_3).(\overline{x}_1 + \overline{x}_2 + \overline{x}_3).(\overline{x}_1 + x_2 + \overline{x}_3).(\overline{x}_1 + x_2 + x_3)$
2. $f(x_1, x_2, x_3) = (\overline{x}_1 + \overline{x}_2 + \overline{x}_3).(x_1 + x_2 + x_3).(x_1 + \overline{x}_2 + x_3).(x_1 + \overline{x}_2 + \overline{x}_3)$
3. $f(x_1, x_2, x_3) = (x_1 + x_2 + \overline{x}_3).(\overline{x}_1 + x_2 + x_3).(\overline{x}_1 + x_2 + \overline{x}_3).(\overline{x}_1 + \overline{x}_2 + x_3)$
4. $f(x_1, x_2, x_3) = (\overline{x}_1 + x_2 + \overline{x}_3).(\overline{x}_1 + x_2 + x_3).(x_1 + \overline{x}_2 + \overline{x}_3).(\overline{x}_1 + \overline{x}_2 + x_3)$
5. $f(x_1, x_2, x_3) = (x_1 + x_2 + \overline{x}_3).(\overline{x}_1 + x_2 + x_3).(x_1 + \overline{x}_2 + \overline{x}_3).(x_1 + \overline{x}_2 + \overline{x}_3)$

13. What are the essential prime implicants of f(A,B,C,D)=Π(0,1, 6, 9, 11, 12, 14)

1. A'B'C, A'CD, B'CD'
[2.] A'BC', AB'D', BD
3. A'BC', A'CD, BD
4. A'B'C, AB'D', BD
5. None of the above

14. In Figure 2, if $A_3A_2A_1A_0$=1001, $B_3B_2B_1B_0$=1101 and S=1 then the output is:

1. Sum = 0110 and C_4 = 0
2. Sum = 0110 and C_4 = 1
[3.] Sum = 1100 and C_4 = 0
4. Sum = 1100 and C_4 = 1
5. none of the above

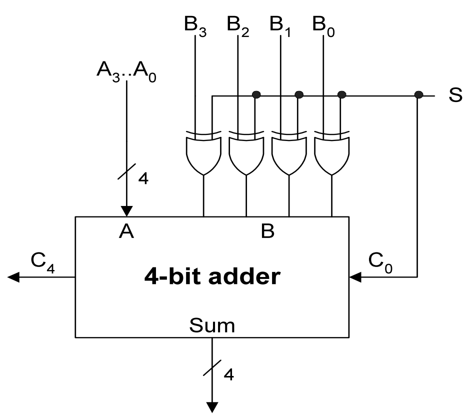

Figure 2 – Circuit for questions 14 and 15. Note, c_0 is carry in and c_4 is carry out for the 4-bit adder.
***Reminder:* This adder and subtractor unit operates on 2's complement numbers and the S input signal determines whether an addition or subtraction will occur.**

15. In Figure 2, overflow occurs for:

1. $A_3A_2A_1A_0$=0100, $B_3B_2B_1B_0$=1010 and S=0
2. $A_3A_2A_1A_0$=0100, $B_3B_2B_1B_0$=0110 and S=1
3. $A_3A_2A_1A_0$=1100, $B_3B_2B_1B_0$=0110 and S=0
[4.] $A_3A_2A_1A_0$=1100, $B_3B_2B_1B_0$=1010 and S=0
5. none of the above

16. You were asked to implement the following four functions with half-adders:

f_1=A⊕B⊕C
f_2=A'BC+AB'C
f_3=ABC'+(A'+B')C
f_4=ABC
What is the minimum number of half-adders required to implement all four functions simultaneously? (you are not allowed to use any other logic element). Hint: the circuit of a half-adder is shown in Fig. 3
1. 2
2. 3
3. 4
4. 5
5. 6

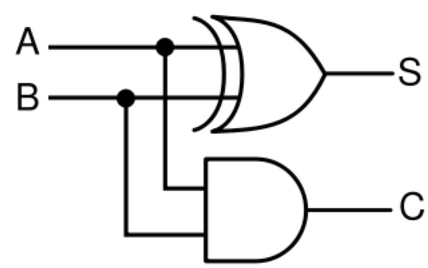

Figure 3: Circuit of a half-adder

17. Consider the oscillator circuit shown in Figure 4(a), which produces a periodic signal (**OUTPUT**) with a period of 100 ns, as shown in Figure 4(b). Let's assume that the 2-input NOR gate's propagation delays from low to high and high to low are equal and they are labeled as T_{pd}. Then the value of T_{pd} is:

1. 10 ns
2. 20 ns
3. 25 ns
4. 50 ns
5. none of the above

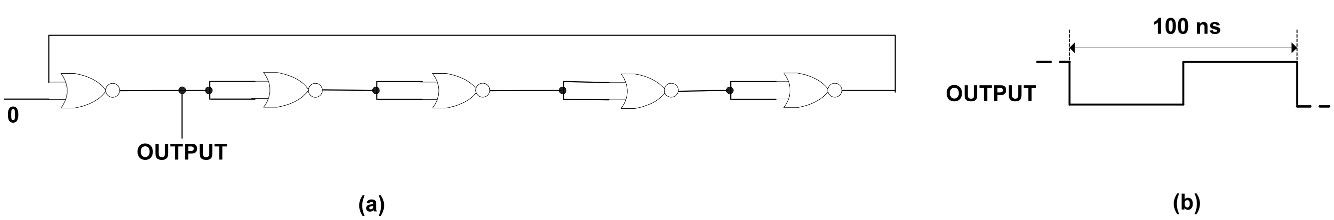

Figure 4 - Circuit and waveform for question 17.

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

Figure 5 - Karnaugh map for function F(A,B,C,D) for question 18. Note, 'X' stands for don't care.

18. Consider the function **F(A,B,C,D)** shown in Figure 5. The simplified logical expression in the sum-of-products (SOP) form (i.e., the minimum number of product terms and the minimum number of literals in every product term) for **F(A,B,C,D)** can be converted into a circuit implementation using only NAND gates, which is shown in:

1. Figure 6(a)
2. Figure 6(b)
3. Figure 6(c)
4. Figure 6(d)
5. none of the above

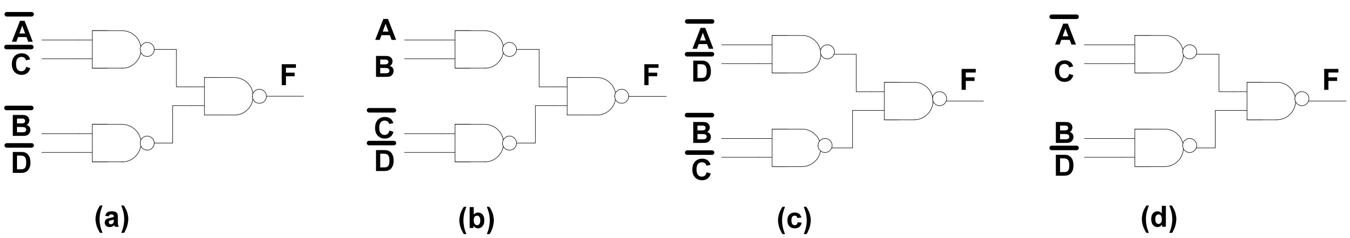

Figure 6 - Implementations for function F(A,B,C,D) for question 18.

19. Which of the circuits shown in Figure 7 are equivalent (i.e., the logic functions they implement have identical truth tables)?

1. Figure 7(a) and Figure 7(c)
2. Figure 7(a) and Figure 7(d)
3. Figure 7(b) and Figure 7(c)
4. Figure 7(b) and Figure 7(d)
5. none of the above

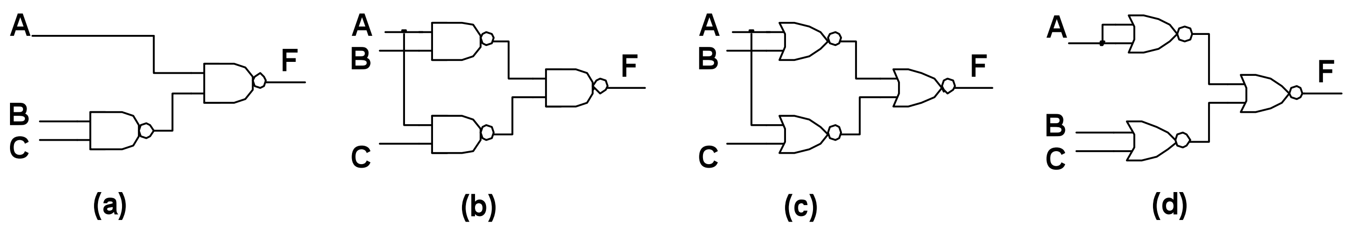

Figure 7 - Circuits function for question 19

20. All the essential prime implicants of **F(A,B,C,D)** shown in Figure 8 are:

1. A'B'D', A'BC', ABD, AB'C
2. A'C'D', BC'D, ACD, B'CD'
3. BD, B'D'
4. this function does not have essential prime implicants
5. A'C'D, ABD'

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

Figure 8 - Karnaugh map for function F(A,B,C,D) for questions 20.

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