Department of Electrical and Computer Engineering
University of Wisconsin–Madison

ECE 553: Testing and Testable Design of Digital Systems
Fall 2011

Assignment #2
Date Tuesday, September 27, 2011
Due date Thursday, October 6, 2011

1. (10 points) For the logic circuit in figure 1, Compute a) the total number of single stuck-at faults b) the total number of stuck-open faults c) the total number of all possible multiple stuck-at fault combinations (assume 2-inputs NANDs and NORs use 4 Transistors, 2-input ANDs and OFs use 6 transistors, and NOTs use 2 transistors).

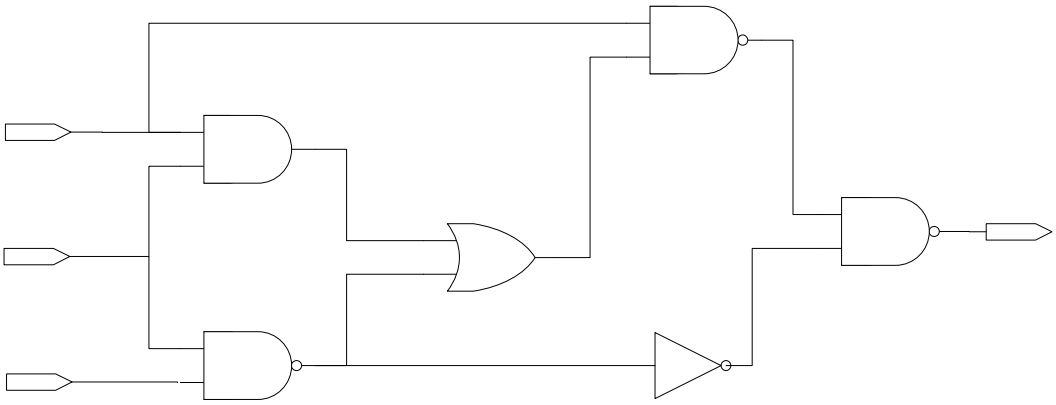

Figure 1: Figure for Problem 1

2. (15 points) (Bushnell and Agrawal) Problem 4.5

3. (10 points) Show that the two faults a s-a-0 and c s-a-1 are equivalent in the circuit of figure 2.

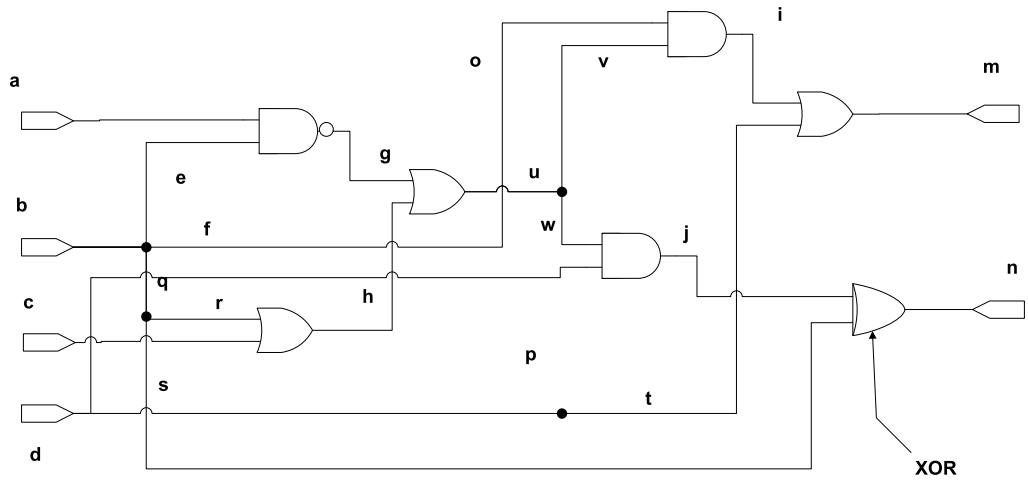

Figure 2: Figure for Problem 3

4. (30 points) For this problem you will use the circuit given in Figure 3.

   (a) (10 points) The Table 1 gives a fault list for the circuit of Figure 3, after equivalence fault collapsing. Fill in the blanks with equivalent fault sets for each listed fault. (Validity check: the total number of faults in table should be 40)

   (b) (10 points) Assume that you are applying exhaustive test set for the circuit in Figure 3. In the Table 2, mark all the faults that are detected by each vector. Note that only the collapsed faults are listed in Table 2. *For this problem you are allowed to use fault simulator (SFSP) of TESTCAD toolset*

   (c) (10 points) From the cover table of (b),

      i. find minimum number of vectors that detect all detectable faults.

      ii. list a minimum test set.

5. (10 points) (Bushnell and Agrawal) Problem 4.11

6. (10 points) (Bushnell and Agrawal) Problem 4.12. Please use the definition given in the text (Definition 4.7 on page 78) for checkpoints in a circuit. Note : For those who have older version of text, the definision of check point is slightly modified as follows. *Checkpoints : Primary inputs and fanout branches of a combinational circuit consisting*

Fault	List all equivalent Faults
1/1	$\emptyset$
9/0	
9/1	
5/1	
2/0	
2/1	
10/0	
6/1	
7/1	
3/0	
3/1	
11/0	
11/1	
8/1	
4/1	
17/1	
14/1	
15/1	10/1, 12/1
12/0	
18/1	
19/0	
19/1	
20/0	
20/1	

Table 1: Table for problem 4(a), *Print this page, fill and submit with your work*

1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
2	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1
3	0	0	1	1	0	0	1	1	0	0	1	0	1	0	1	1
4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
1/1																
9/0																
9/1																
5/1																
2/0																
2/1																
10/0																
6/1																
7/1																
3/0																
3/1																
11/0																
11/1																
8/1																
4/1																
17/1																
14/1																
15/1																
12/0																
18/1																
19/0																
19/1																
20/0																
20/1																

Table 2: Table for problem 4(b), *Print this page, fill and submit with your work*

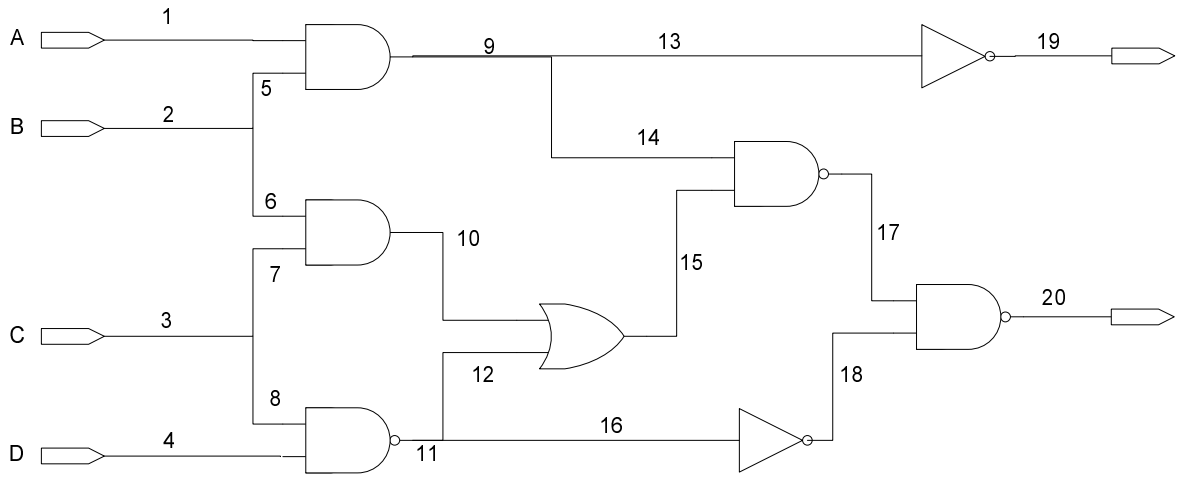

Figure 3: Figure for Problem 4

only of BOOLEAN gates are called the checkpoints. Thus, expend XOR gate as in Figure 4.9 in the text.

7. (10 points) (Bushnell and Agrawal) Problem 5.25