

Name Answers

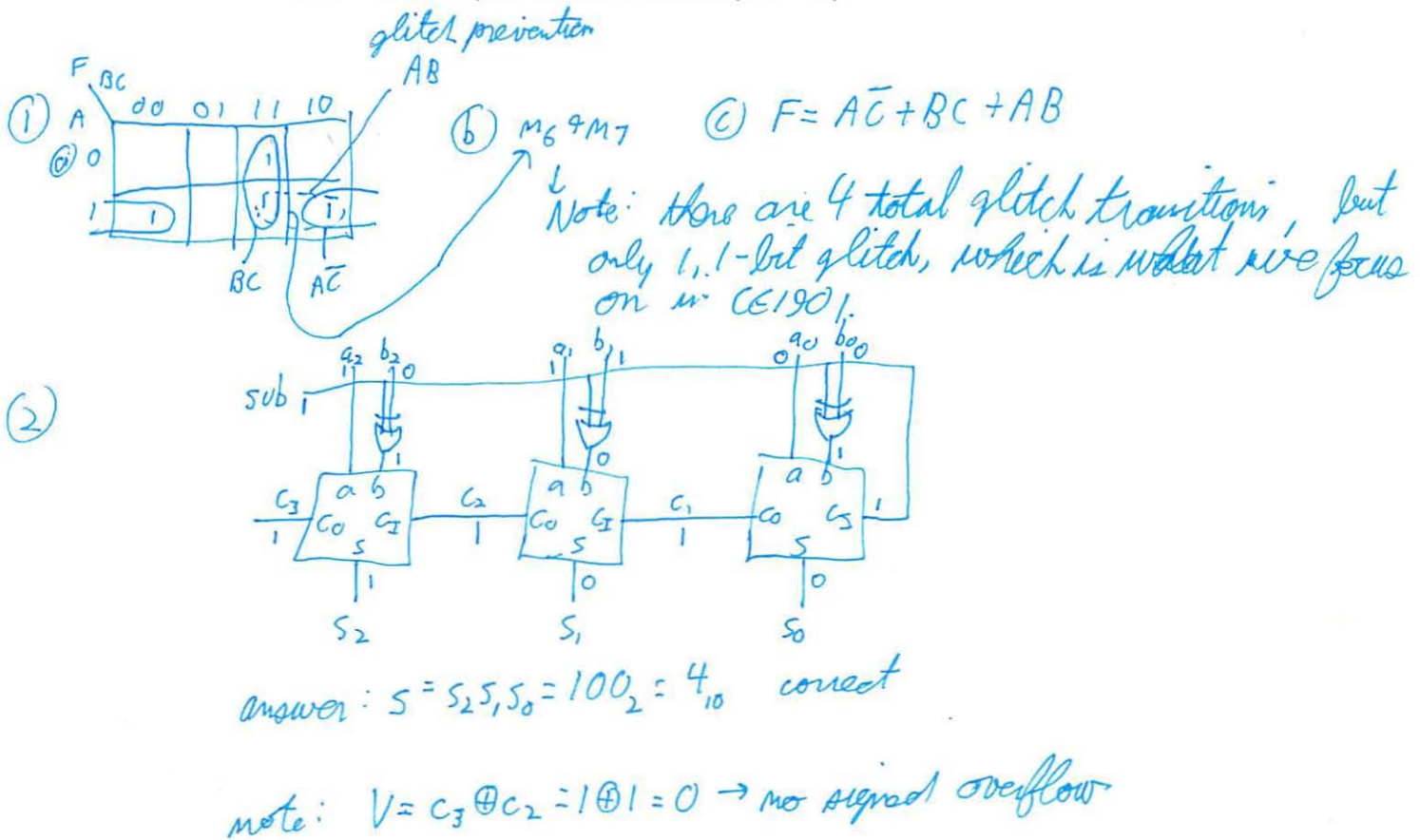
CE-1901 - Dr. Durant - Quiz 7  
Fall 2015, Week 7 Quiz

1. (2 points) Glitches

- Draw the K-map for  $F(ABC) = AC' + BC$ .
- Determine between which pair(s) of minterms a glitch may occur.
- Modify the expression for  $F$  to avoid all glitches.

2. (3 points) Subtraction

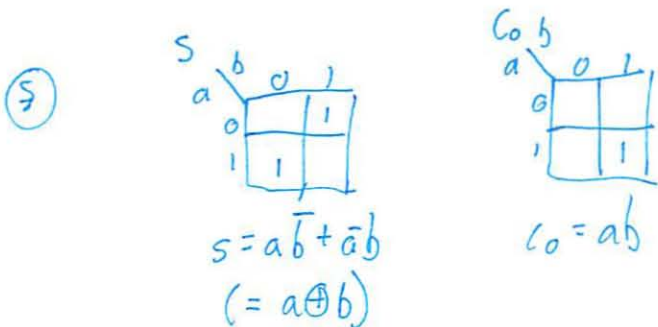
- (2 points) Draw the block diagram for the 3-bit ripple-carry adder-subtractor (RCAS3). Use full adder (FA) blocks. Hint: You need a "sub"tract input and 3 XOR2 gates.
- (1 point) Label the inputs to your RCAS3 so that it is subtracting  $B=010$  from  $A=110$ . Show the logic value of every node in the circuit (but not the internal details of the FAs). Comment on whether your answer is correct ( $6-2=4$ ?).



3. (1 point) Using K-maps, derive the **minimized** sum **and** carry out equations for the half (not full) adder.
4. (2 points) Recall that the carry-lookahead adder (CLA) uses propagate and generate signals  $p_i = a_i + b_i$  and  $g_i = a_i b_i$ . For a 4-bit CLA, **write** the **fast** carry out ( $c_4$ ) equation in terms of the propagate and generate signals. (Partial credit for only writing the nested/slow form of the equation.)
5. (2 points) Assume that gate delay  $\tau = 50$  ps. **Approximate** the speed (propagation delay) of **both** a 64-bit RCA **and** a CLA using 8, **8-bit** lookahead modules. By **what factor** is the CLA faster? Note: make reasonable approximations about the number of gate delays; your answer need not be exact.

(1/4) right k-map, no eq.

(1/2)  $\tau_{FA} = \tau_{2,3}$   
 (1/2) approx right but little/no work/explain



WRONG ④  
 NEED TO FIT - SEE BELOW

~~$c_4 = g_3 + p_3(g_2 + p_2(g_1 + p_1(g_0 + p_0 c_0)))$  ← nested/slow~~  
 ~~$= p_3 g_3 + p_3 p_2 g_2 + p_3 p_2 p_1 g_1 + p_3 p_2 p_1 p_0 c_0$  ← answer, fast~~

⑤ RCA64: assume 3 delays per FA  $\therefore \tau_{FA} = 3 \times \tau = 150$  ps  
 total delay =  $N \tau_{FA} = 64 \cdot 150$  ps = 9600 ps = 9.6 ns

CLA8-64:  $c_8$  delay = 3 gates (① p, g layer, ② products from 4, ③ sum from 4)  
 $= 3\tau = 150$  ps  
 $\tau_{C56} = 7 \times (c_8 \text{ delay}) = 1050$  ps ← delay into final CLA8  
 ripple delay into  $S_{63}$  in most significant CLA8:  
 $\tau_{S63} = 8 \times 150$  ps = 1200 ps = 1.2 ns  
 FROM RCA64      relative to  $C_{56}$   
 total for CLA8-64 =  $\tau_{C56} + \tau_{S63} = 1050$  ps + 1200 ps = 2350 ps = 2.35 ns

speedup =  $\frac{9.6 \text{ ns}}{2.35 \text{ ns}} = \boxed{\text{approximately 4 times}}$

④  $c_4 = g_3 + p_3(g_2 + p_2(g_1 + p_1(g_0 + p_0 c_0)))$  ← nested/slow  
 $= g_3 + p_3 g_2 + p_3 p_2 g_1 + p_3 p_2 p_1 g_0 + p_3 p_2 p_1 p_0 c_0$  ← answer, fast