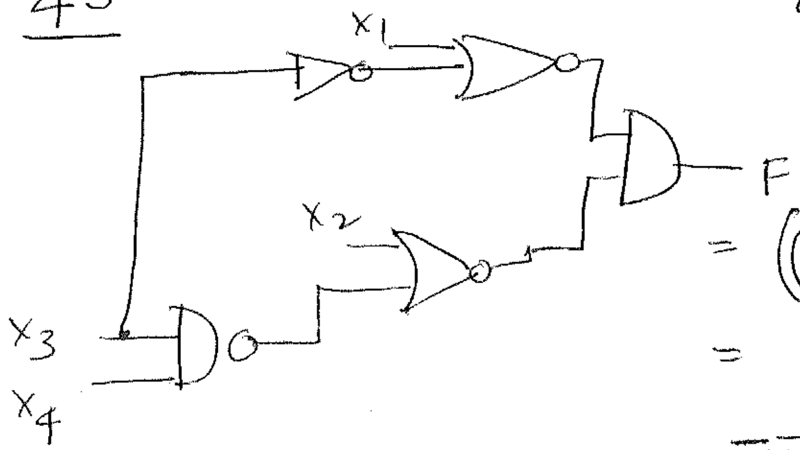
HW 1 Solutions

4.3



a) AND bridge

$$F = \left(\overline{\overline{x_3 \cdot x_4} + x_2}\right) \cdot \overline{x_1 \cdot \overline{x_3}}$$

$$= \left(\overline{(\overline{x_3} + \overline{x_4}) + x_2}\right) \cdot (\overline{x_1} + x_3)$$

$$= x_3 \cdot x_4 \cdot \overline{x_2}\,(\overline{x_1} + x_3)$$

$$= \overline{x_2}\, x_3 \cdot x_4 + \overline{x_2}\, x_3 x_4 \overline{x_1}$$

$$= \overline{x_2}\, x_3 x_4$$

(b) Equivalent ckt for $\{x_3 \sim, x_2 \times\}$

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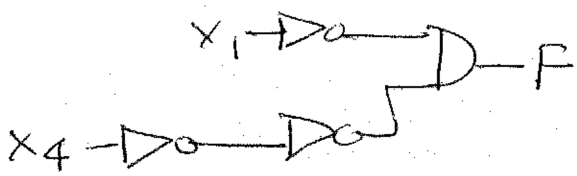


$F = \overline{x_1}\, x_4$.

4.5 (a) $F_{fault\text{-}free} = \left(\overline{\overline{x_3 \cdot x_4} + x_2}\right) \cdot \left(\overline{\overline{x_3} + x_1}\right)$

$$F_{x_3\, s\text{-}a\text{-}0} = F = 0$$

Now $F_{ff} = \left(\overline{\overline{x_3 \cdot x_4}} \cdot \overline{x_2}\right) \cdot (x_3 \cdot \overline{x_1})$

$$= \overline{x_1}\, \overline{x_2}\, x_3 \cdot x_4$$

So complete test set is given by.

$$F_{x_3 s\text{-}a\text{-}0} \oplus F_{ff} = 1$$

or $\overline{x_1}\,\overline{x_2}\,x_3 \cdot x_4 \oplus 0 = 1$.

$\Rightarrow \overline{x_1}\,\overline{x_2}\,x_3 x_4 = 1$ (Boolean exp)

Test = {0011} (one test)

(b) x_2 s-a-0

$F_{x_2\,s\text{-}a\text{-}0} = \overline{x_1}\, x_3 x_4$.

So $\overline{x_1} x_3 x_4 \oplus \overline{x_1}\,\overline{x_2}\,x_3 \cdot x_4 = 1$

or

$\overline{x_1} x_3 x_4 \cdot (x_1 + x_2 + \overline{x_3} + \overline{x_4}) + \overline{x_1}\,\overline{x_2} x_3 x_4 \cdot (x_1 + \overline{x_3} + \overline{x_4}) = 1$

or $\overline{x_1} x_2 x_3 x_4 + 0 = 1$ or $\overline{x_1} x_2 x_3 x_4 = 1$ (Boolean exp)

Test = {0011} (one test).

(c) x_2 s-a-1 $\Rightarrow F = 0$ (this is the same as case (a))

$\overline{x_1}\,\overline{x_2}\,x_3 x_4 = 1$.

Test = {0011} (one test.

Prob 4.8

$$Z_1 = \overline{C} + A \cdot B$$
$$Z_2 = C \cdot A \cdot B + A \cdot B = A \cdot B$$

a) for b s-a-1.

$$Z_{1f} = \overline{C} + A \cdot B$$
$$Z_{2f} = A \cdot B + A \cdot B = A \cdot B$$

$$\left.\begin{array}{l} Z_{1f} \oplus Z_1 = 0 \\ Z_{2f} \oplus Z_2 = 0 \end{array}\right\}$$ b s-a-1 is undetectable

b)

$$Z_{1a_0} = \overline{C} \qquad Z_{1c_0} = \overline{C}$$
$$Z_{2a_0} = C \cdot A \cdot B \qquad Z_{2c_0} = A \cdot B.$$

$$Z_{1a_0} \oplus Z_{1c_0} = 0$$
$$Z_{2a_0} \oplus Z_{2c_0} = CAB \oplus AB$$
$$= A \cdot B \cdot (C\overline{C} + \overline{A} + \overline{B})$$
$$\Rightarrow \quad AB\overline{C} = 1.$$

so test $= \{110\}$

c) distinguish multiple fault

$f_1 = \{a_{s\text{-}a\text{-}0}, b_{s\text{-}a\text{-}1}\}$, $\{c_{s\text{-}a\text{-}0}, b_{s\text{-}a\text{-}1}\} = f_2$.

$$Z_{1f_1} = \overline{C} \qquad Z_{2f_1} = A \cdot B$$

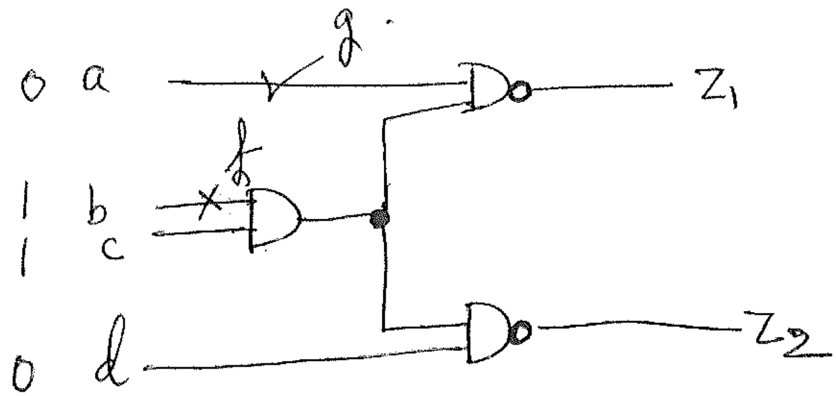
$$Z_{1f_2} = \overline{C} \qquad Z_{2f_2} = A \cdot B$$

Since $Z_{1f_1} \oplus Z_{1f_2} = 0$

and $Z_{2f_1} \oplus Z_{2f_2} = 0$

There is no test.

Prob 4.17



Under fault g, $Z_1 Z_2 = 01$

under fault $\{f, g\}$, $Z_1 Z_2 = 11$

Under no fault $Z_1 Z_2 = 11$

a.) f masks g under test 0110

Under test 0111, $Z_1 Z_2 = 00$ under fault g

$Z_1 Z_2 = 11$ under fault $\{f, g\}$

$Z_1 Z_2 = 10$ under no fault.

So f does not mask g under test 0111

b) Are the faults f, and $\{f, g\}$ distinguishable?

$Z_{1f} = 1$, $Z_{2f} = 1$

$Z_{1\{f,g\}} = 1$, $Z_{2\{f,g\}} = 1$

Hence not distinguishable.