

HOMEWORK 5

Solutions

1.

		xy			
		00	01	11	10
z	0	1	1	1	
	1	1		1	1

		0	1	2	5	6	7
Prime Implicants	0-0	x		x			
	-10			x		x	
	1-1					x	x
	00-	x	x				
	11-					x	x
	-01		x			x	

$$F = X'Z' + XY + Y'Z$$

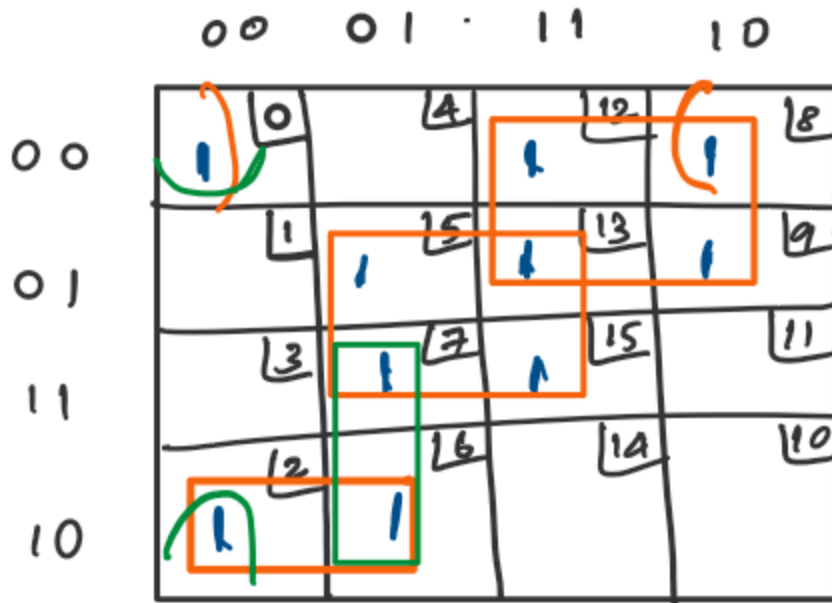
Another possibility : $F = X'Y' + XZ + YZ'$

2.

A properly designed two-level sum-of-products (AND-OR) circuit has no static-0 hazards. A static-0 hazard would exist in such a circuit only if both a variable and its complement were connected to the same AND gate, which is generally not useful and not implemented.

3.

○ → static hazard possibility

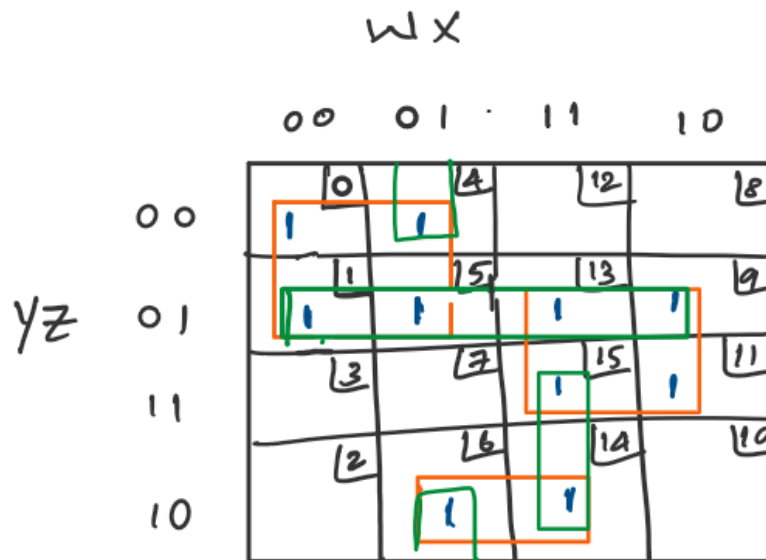


Static 1 hazard can occur when PQRS changes as: 0111 ↔ 0110, 0000 ↔ 0010

4. $F(P, Q, R, S) = QS + PR' + P'QS + P'Q'S' + P'RS' + Q'R'S'$

5.

○ → static hazard possibility



Static 1 hazard can occur when WXYZ changes as:

0100 ↔ 0110

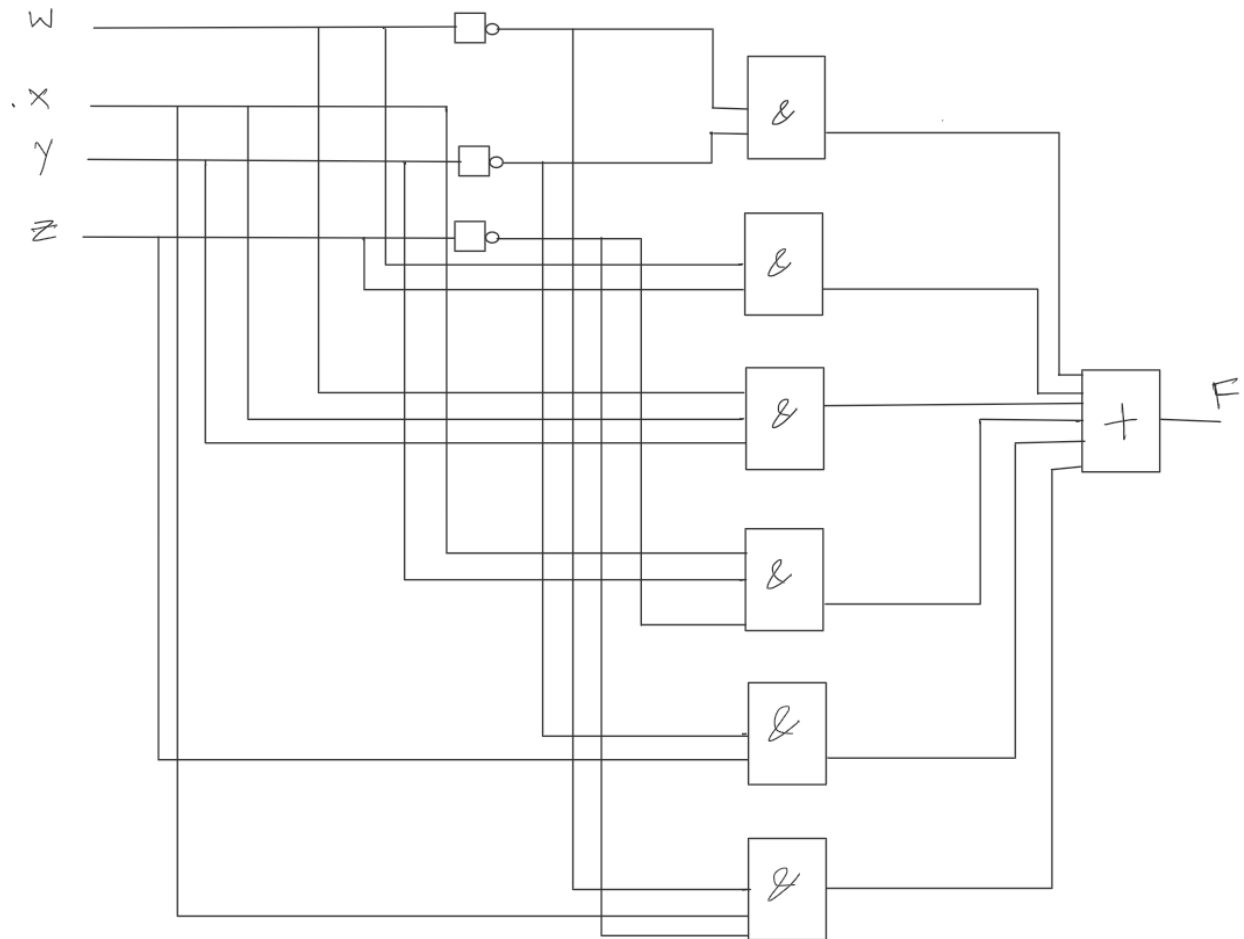
0001 ↔ 1001

1111 ↔ 1110

0101 ↔ 1101

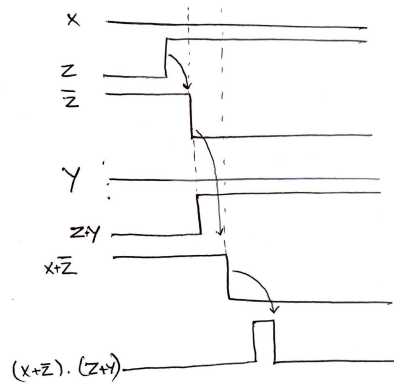
6.

$$F = W'Y' + WZ + WXY + XYZ' + Y'Z + W'XZ'$$

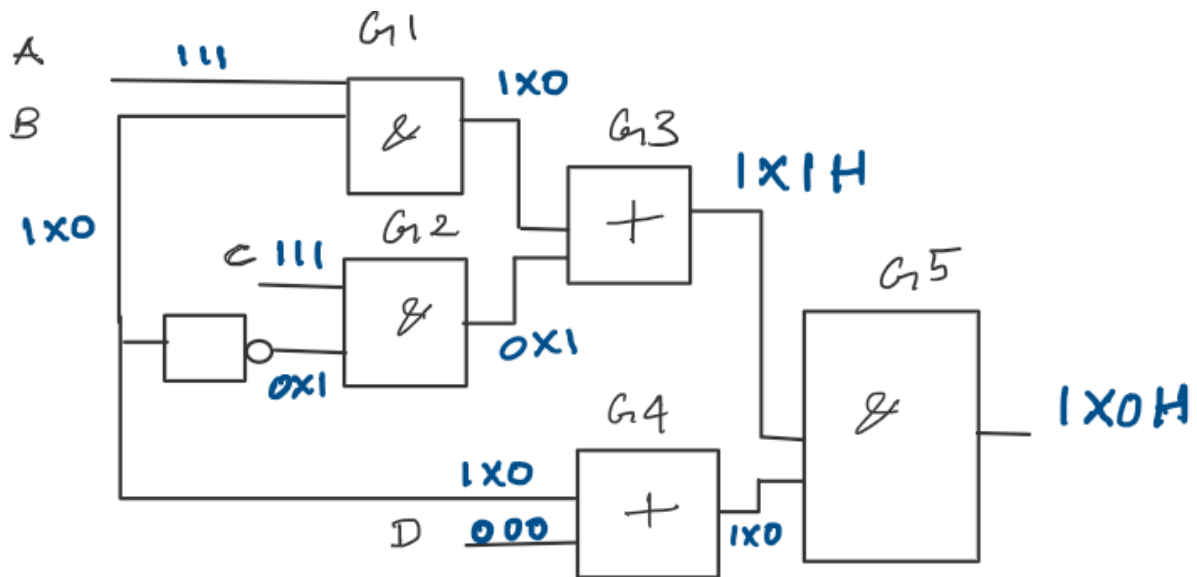


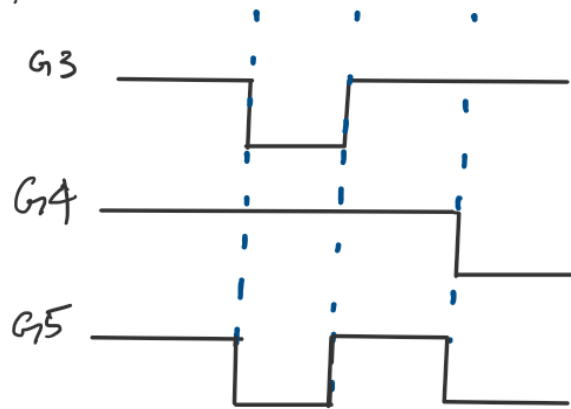
7.

From the timing diagram below, we see that the circuit leads to a static 0 hazard at the output.



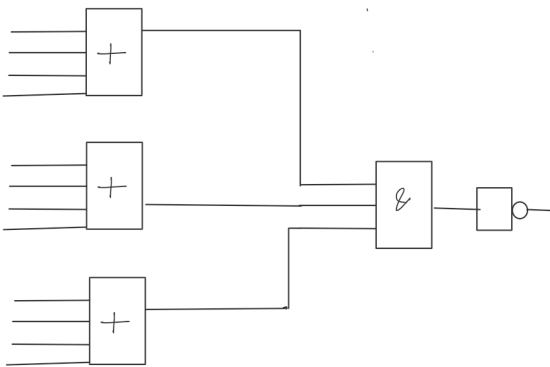
8.





There is a possibility of dynamic hazard. Consider the case where the output of AND gate G1 switches to "0" quickly, when output of AND gate G2 still remains at "0". The output of OR gate G3 may switch to "0" from "1" and the final output may switch to "0" from "1". When output of G3 goes high again and output of G4 remains at "1", the final output switches from "0" to "1". The output again changes from "1" to "0" when output of G4 transitions from "1" to "0". Since the output changes more than once for a single input change, this is a dynamic hazard.

9.



10.

The DC Noise Margins are:

$$V_{OHmin} - V_{IHmin} = 1.4 \text{ V}$$

$$V_{ILmax} - V_{OLmax} = 1.4 \text{ V}$$