CSE1003
Problems

Design a logic circuit that has three inputs, *A*, *B*, and *C*, and whose output will be HIGH only when a majority of the inputs are HIGH.

Step 1. Set up the truth table.

A	B	C	x
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Step 2. Write the AND term for each case where the output is a 1.

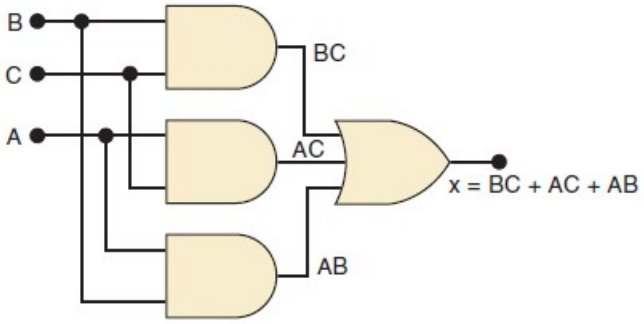
Step 3. Write the sum-of-products expression for the output.

$$x = \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC$$

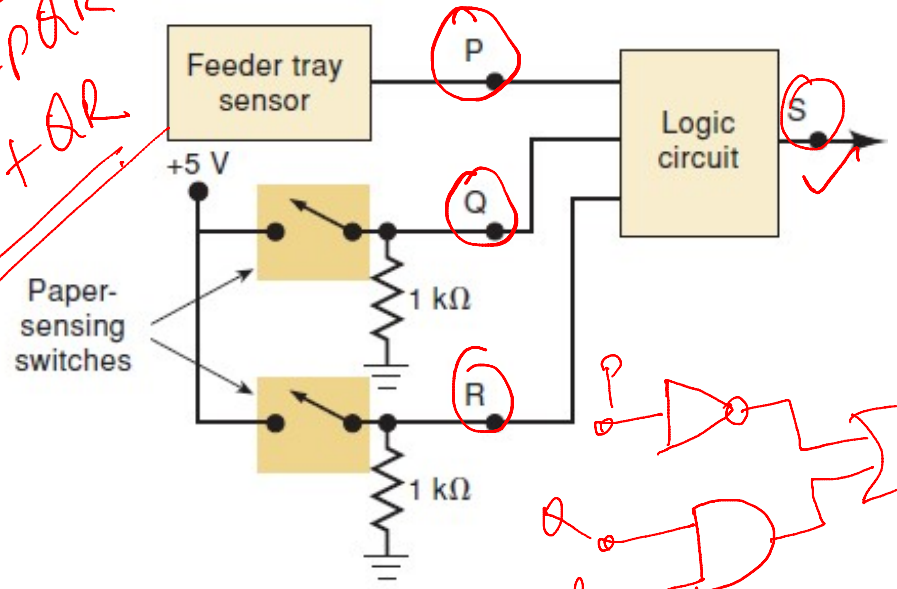
Step 4. Simplify the output expression.

$$x = BC + AC + AB$$

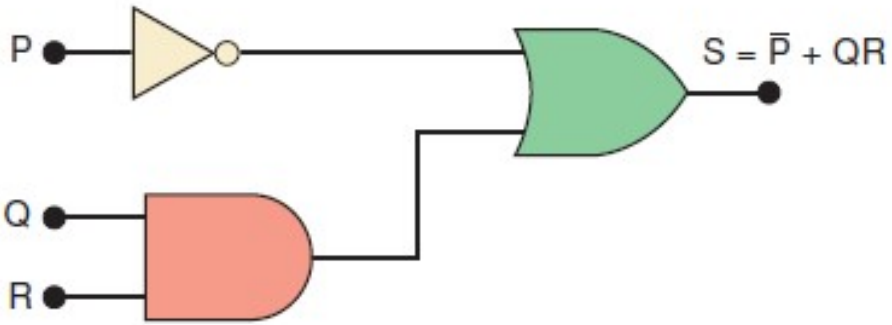
Step 5. Implement the circuit for the final expression.

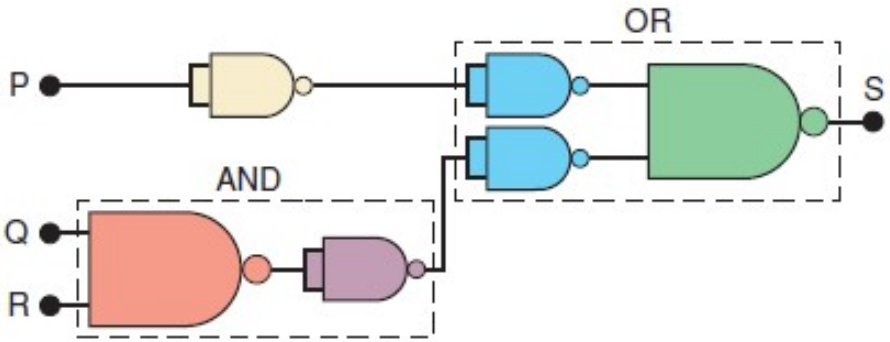


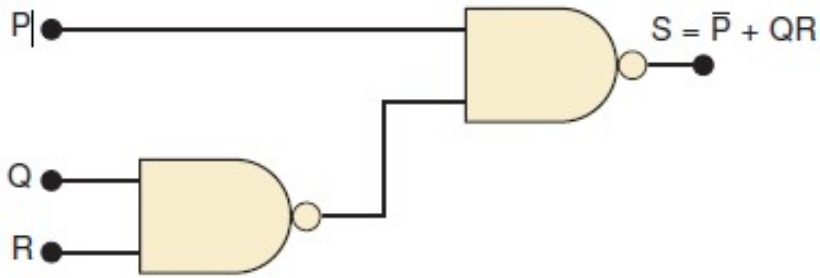
- In a simple copy machine, a stop signal, *S,* is to be generated to stop the machine operation and energize an indicator light whenever either of the following conditions exists: (1) there is no paper in the paper feeder tray; or (2) the two microswitches in the paper path are activated, indicating a jam in the paper path. The presence of paper in the feeder tray is indicated by a HIGH at logic signal *P.* Each of the microswitches produces a logic signal (*Q* and *R*) that goes HIGH whenever paper is passing over the switch to activate it. Design the logic circuit to produce a HIGH at output signal *S* for the stated conditions, and implement it using the 74HC00 CMOS quad two-input NAND chip.



P	Q	R	S
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1


P
Q
R
S = P̄ + QR


OR
AND
P
Q
R
S


P
Q
R
S = P̄ + QR

Simplify $f = A'BC' + AB'C' + ABC$ using maxterms. Using K-Map method.

$f = A'BC' + AB'C' + ABC$

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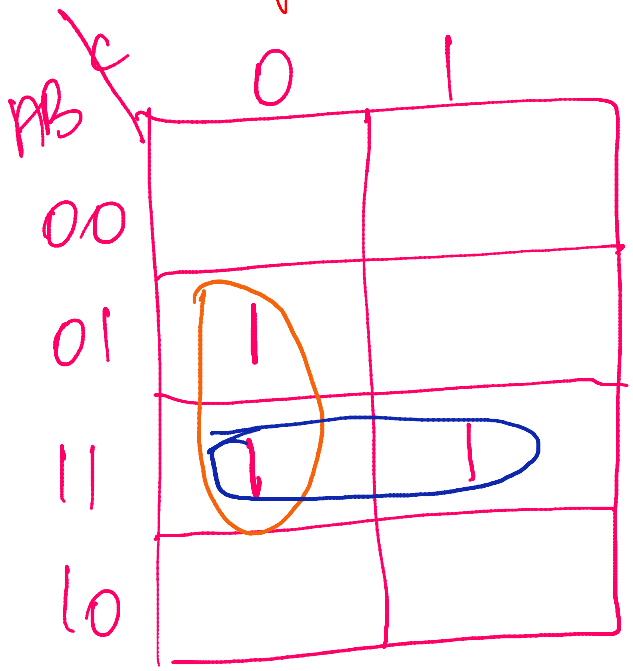
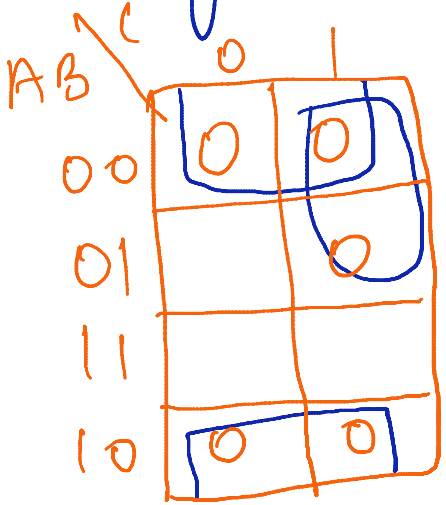


Using minterms

$f = BC' + AB$ SOP form

Using maxterms - place 0's in the remaining squares



The group of 0's provides the complement of the function

$$\overline{F} = \overline{B} + \overline{A}C$$

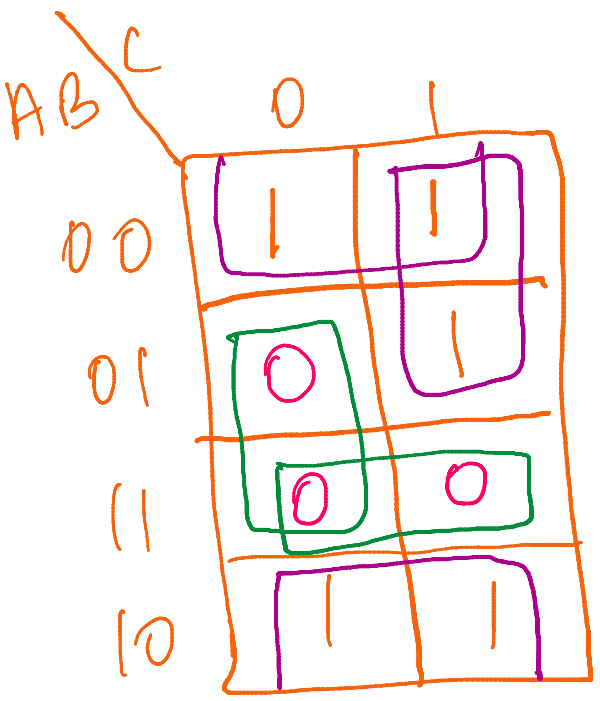
$$F = \overline{\overline{F}} = \overline{\overline{B} + \overline{A}C} = \overline{\overline{B}}\,(\overline{\overline{A}} + \overline{C})$$

$$f = B(A + \overline{C}) \quad \text{POS form}$$

Simplify the following Boolean function into SOP & POS forms.

$$F(A,B,C) = \Sigma(0,1,3,4,5)$$

Fill in 1's in the squares of minterms for which F=1
& Fill in 0's in the remaining squares for which F=0
Group of 1's provide the SOP form
Group of 0's provide the complement of the function



Group of 1's — SOP form

$$F = \bar{B} + \bar{A}C$$

Group of 0's — Complement of F

$$\bar{F} = B\bar{C} + AB$$

$$f = \bar{\bar{F}} = \overline{B\bar{C} + AB} = \overline{B\bar{C}} \cdot \overline{AB}$$

$$= (\bar{B} + \bar{\bar{C}}) \cdot (\bar{A} + \bar{B})$$

$$= (\bar{B} + C)(\bar{A} + \bar{B})$$

Give Simplified logic equation & Table by QM method.

	A	B	C	Y
m_0	0	0	0	0
m_1	0	0	1	0
m_2	0	1	0	1
m_3	0	1	1	0
m_4	1	0	0	0
m_5	1	0	1	0
m_6	1	1	0	1
m_7	1	1	1	1

Stage 1

Minterms	Binary A B C	Group
m_2	0 1 0	I
m_6	1 1 0	II
m_7	1 1 1	II

Stage 2

Minterms	Binary A B C	
2, 6	- 1 0	PI1
6, 7	1 1 -	PI2

$Y = B\bar{C} + AB$

Prime Implicant chart

		2	6	7	
2,6	PI1	✓	✓		EPI
6,7	PI2		✓	✓	EPI