variables x, y, z and the last column in the above table.

4. Find a switching circuit which realizes the switching function f given by the following switching table:

x	y	z	$f(x,y,z)$
1	1	1	0
1	1	0	1
1	0	1	1
1	0	0	0
0	1	1	0
0	1	0	0
0	0	1	0
0	0	0	1

Solution: Consider the 2nd, 3rd and 8th rows of the table where f takes the value 1. We get the Boolean expression representing the given function as

$xyz' + xy'z + x'y'z'$. The circuit which realizes the Boolean expression is

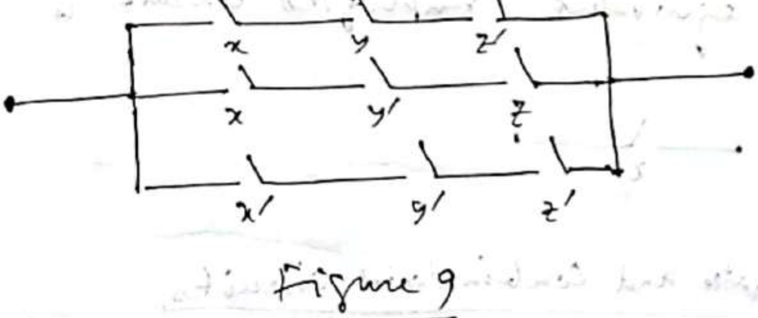


Figure 9

5. Obtain a Boolean expression which represents the following circuit in Figure 10. Draw an equivalent circuit as simple as you can.

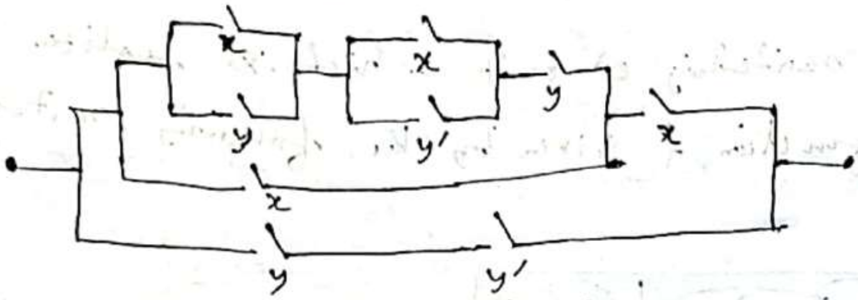


Figure 10

Solution: The Boolean expression representing the circuit is:

$$\{(x+y)(x+y')y+x\}x+yy'$$

$$=[\{x(x+y')+y(x+y')\}y+x]x+0$$

$$=\{(x+xy'+yx+0)y+x\}x$$

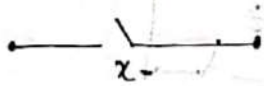
$$=[\{x+x(y+y')\}y+x]$$

$$=\{(x+x)y+x\}$$

$$=x+xy+x=xy+x=x(y+1)$$

$$=x.1=x$$

Hence the equivalent simplified circuit is



Logical Gates and Combinatorial circuits

One of the most important application of Boolean algebra is to the designing and simplification of digital electronic circuits such as that used in computer hardware.

In a digital computer, the smallest indivisible object is a bit. All programs and data in a computer can ultimately be reduced to a combination of bits. There are two possibilities for a bit: 1 and 0. We transmit a bit from one part of a circuit to another part as a voltage. For this, we need two voltage labels, say, a high voltage and a low voltage, which can communicate 1 and 0 respectively. In the previous discussion, we discussed two elements Boolean Algebra. In this section, we show the application of two element Boolean Algebra $\{0,1\}$ in the designing of electronic circuits. The input to these circuits is a set of 0's and 1's and they have single output 0 or 1. The Institute of Electrical and Electronics Engineers design some standard symbols to represent the Boolean expression x', $x'y$ and $x+y$

Consider the Boolean expression $\alpha(x) = x'$. We know that $\alpha(0)=1$ and $\alpha(1) = 0$. The Boolean operation, i.e., Complement, can be represented using a device called the NOT gate. The symbol used for the NOT gate is shown in Figure 11

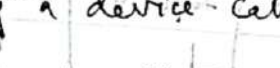


Figure 11

As we can see, in Figure 11, the NOT gate has one input, shown by an arrow to its left and labelled by the variable x and its output is shown by the arrow to its right and labelled by x'

Associate with the NOT gate a table called the input-output table for NOT gate.

NOT gate	Input x	Output x'
	1	0
	0	1

Now Consider the Boolean expression $\alpha(x,y) = xy$, i.e., α is the Boolean product of x and y; We Know That $\alpha(1,1)=1$ $\alpha(1,0)=0$, $\alpha(0,1)=0$ and $\alpha(0,0)=0$.

Boolean product can be represented by a symbol called AND gate. The symbol used for AND gate is shown in figure 12

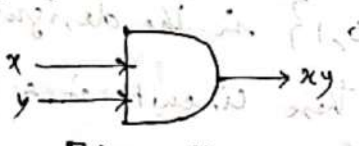


Figure 12

As we can see, in Figure 12, there are two inputs, shown by two arrows to the left and labelled by x and y and its output is shown by an arrow to its right and labelled by the Boolean expression xy.

The input-output table for AND gate is

AND gate	Input x	Input y	Output xy
	1	1	1
	1	0	0
	0	1	0
	0	0	0

The table shows that when the AND gate receives the inputs 1 for x and 1 for y, only then output is 1.

Now consider the Boolean expression $\alpha(x,y) = x+y$

we know that $\alpha(1,1)=1$, $\alpha(1,0) = \alpha(0,1) = 1$ and $\alpha(0,0)=0$

This Boolean expression can be represented by a symbol called OR gate.

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