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ADMISSION NO.: U20CS100

Expt. No:	**9**	**IMPLEMENTATION OF BCD TO EXCESS 3 AND EXCESS 3 TO BCD CONVERTER**
Date:	**14/10/2021**	

AIM: To design and implement BCD TO Excess 3 and Excess 3 to BCD conversion circuit using Multisim.

SOFTWARE TOOLS / OTHER REQUIREMENTS:

1. Multisim Simulator
2. Logic Gates (NAND and NOR Gates)

THEORY:

BCD to Excess-3 conversion

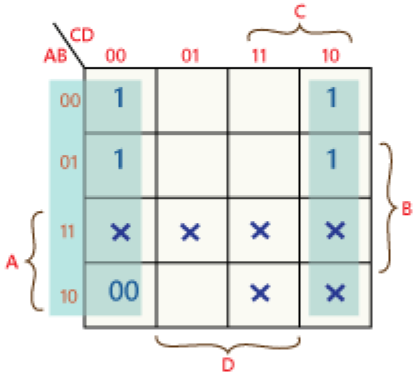
The Excess-3 binary code is an example of a self-complementary BCD code. A self-complementary binary code is a code which is always complimented in itself. By replacing the bit 0 to 1 and 1 to 0 of a number, we find the 1's complement of the number. The sum of the 1'st complement and the binary number of a decimal is equal to the binary number of decimal 9.

The process of converting BCD to Excess-3 is quite simple from other conversions. The Excess-3 code can be calculated by adding 3, i.e., 0011 to each four-digit BCD code. Below is the truth table for the conversion of BCD to Excess-3 code. In the below table, the variables A, B, C, and D represent the bits of the binary numbers. The variable 'D' represents the LSB, and the variable 'A' represents the MSB. In the same way, the variables w, x, y, and z represent the bits of the Excess-3 code. The variable 'z' represents the LSB, and the variable 'w' represents the MSB. The 'don't care conditions' is expressed by the variable 'X'.

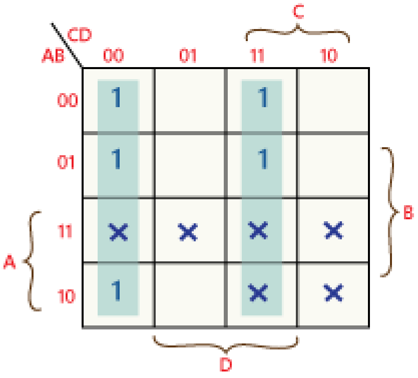
Decimal Number	BCD Code				Excess-3 Code			
	A	B	C	D	W	x	y	z
0	0	0	0	0	0	0	1	1

1	0	0	0	1	0	1	0	0
2	0	0	1	0	0	1	0	1
3	0	0	1	1	0	1	1	0
4	0	1	0	0	0	1	1	1
5	0	1	0	1	1	0	0	0
6	0	1	1	0	1	0	0	1
7	0	1	1	1	1	0	1	0
8	1	0	0	0	1	0	1	1
9	1	0	0	1	1	1	0	0
10	1	0	1	0	X	X	X	X
11	1	0	1	1	X	X	X	X
12	1	1	0	0	X	X	X	X
13	1	1	0	1	X	X	X	X
14	1	1	1	0	X	X	X	X
15	1	1	1	1	X	X	X	X

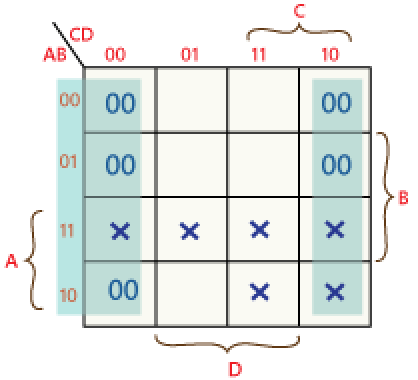
Now, we will use the K-map method to design the logical circuit for the conversion of BCD to Excess-3 code as:



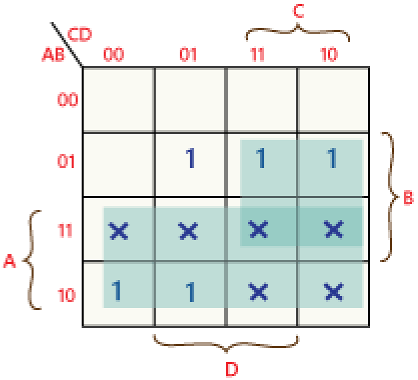
z=D′



y=CD+C′D′



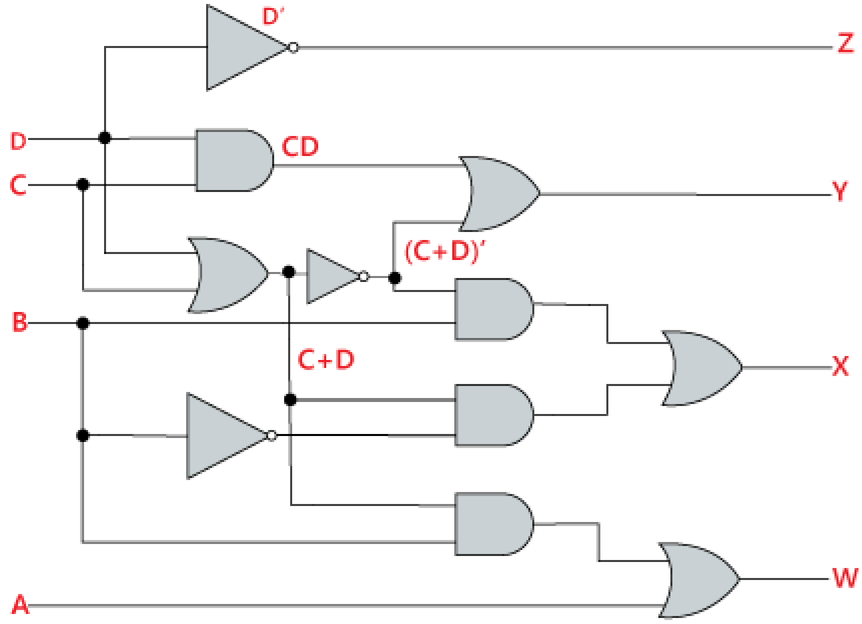
x=B′C+B′D+BC′D′



w=A+BC+BD

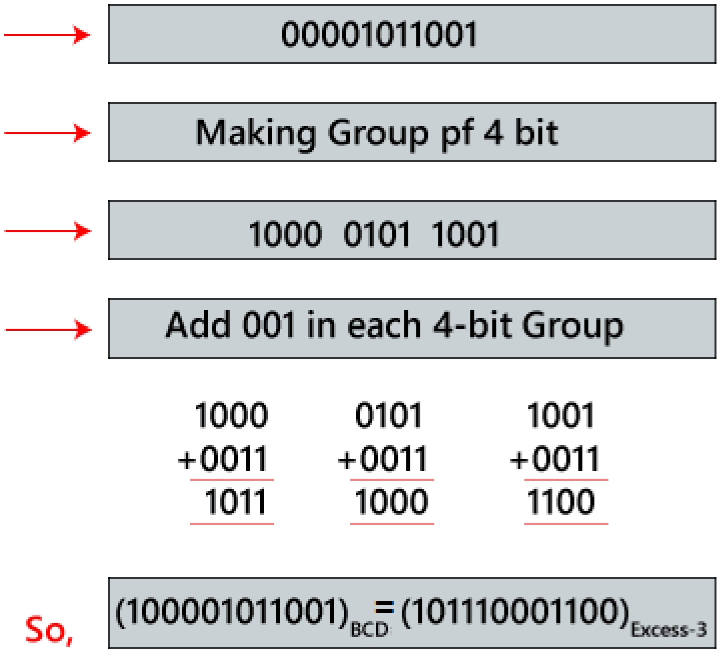
So,

w=A+BC+BD
x=B' C+B' D+BC' D'
y=CD+C'D'
z=D'



Example: $(100001011001)_{BCD}$

To find the Excess-3 code of the given Excess-3 code, first, we will make the group of 4 bits from right to left. Then, we will add 0011 in each group of 4 bits in order to get the excess-3 code.



00001011001

Making Group pf 4 bit

1000 0101 1001

Add 001 in each 4-bit Group

$$\begin{array}{ccc} 1000 & 0101 & 1001 \\ +0011 & +0011 & +0011 \\ \hline 1011 & 1000 & 1100 \end{array}$$

So, $(100001011001)_{BCD} = (101110001100)_{Excess\text{-}3}$

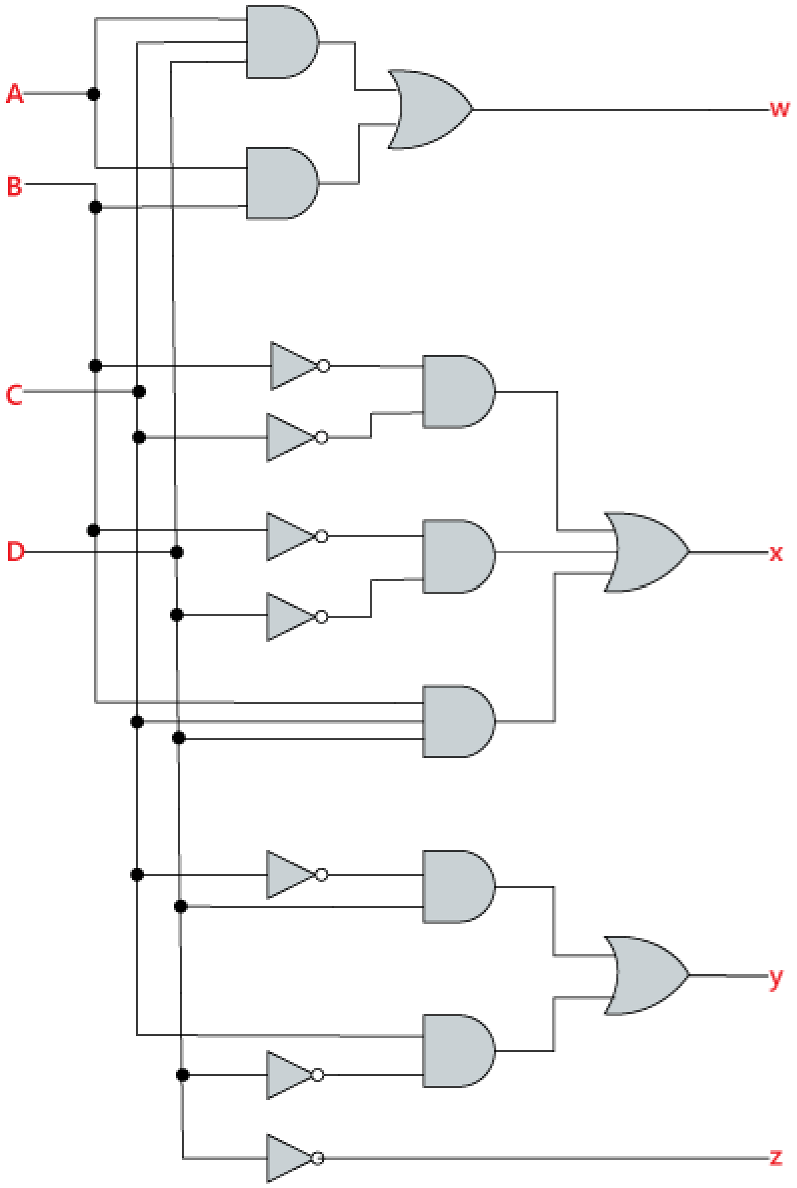
Excess-3 to BCD conversion

The process of converting Excess-3 to BCD is opposite to the process of converting BCD to Excess-3. The BCD code can be calculated by subtracting 3, i.e., 0011 from each four-digit Excess-3 code. Below is the truth table for the conversion of Excess-3 code to BCD. In the below table, the variables w, x, y, and z represent the bits of the Excess-3 code. The variable 'z' represents the LSB, and the variable 'w' represents the MSB. In the same way, the variables A, B, C, and D represent the bits of the binary numbers. The variable 'D' represents the LSB, and the variable 'A' represents the MSB. The 'don't care conditions' is defined by the variable 'X'.

Decimal Number	Excess-3 Code				BCD Code			
	A	B	C	D	W	x	y	z
0	0	0	0	0	X	X	X	X
1	0	0	0	1	X	X	X	X
2	0	0	1	0	X	X	X	X
3	0	0	1	1	0	0	0	0
4	0	1	0	0	0	0	0	1
5	0	1	0	1	0	0	1	0
6	0	1	1	0	0	0	1	1
7	0	1	1	1	0	1	0	0
8	1	0	0	0	0	1	0	1
9	1	0	0	1	0	1	1	0
10	1	0	1	0	0	1	1	1
11	1	0	1	1	1	0	0	0
12	1	1	0	0	1	0	0	1
13	1	1	0	1	X	X	X	X
14	1	1	1	0	X	X	X	X

15	1	1	1	1	X	X	X	X

Now, we will use the K-map method to design the logical circuit for the conversion of Excess-3 code to BCD as:



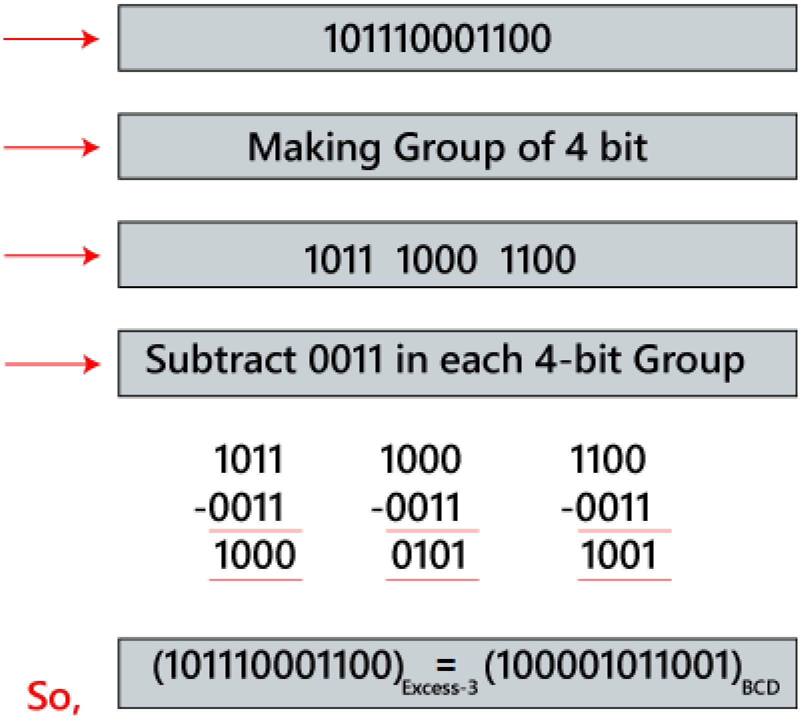
So,

w=AB+ACD
B=x' y'+x' z'+xyz

C=y' z+yz'
D=z'

Example: $(101110001100)_{Excess-3}$

To find the BCD code of the given BCD number, first, we make the group of 4 bits from right to left. Then, we subtract 0011 in each group of 4 bits in order to get the BCD code.



101110001100

Making Group of 4 bit

1011 1000 1100

Subtract 0011 in each 4-bit Group

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 1011     1000     1100
-0011    -0011    -0011
 1000     0101     1001
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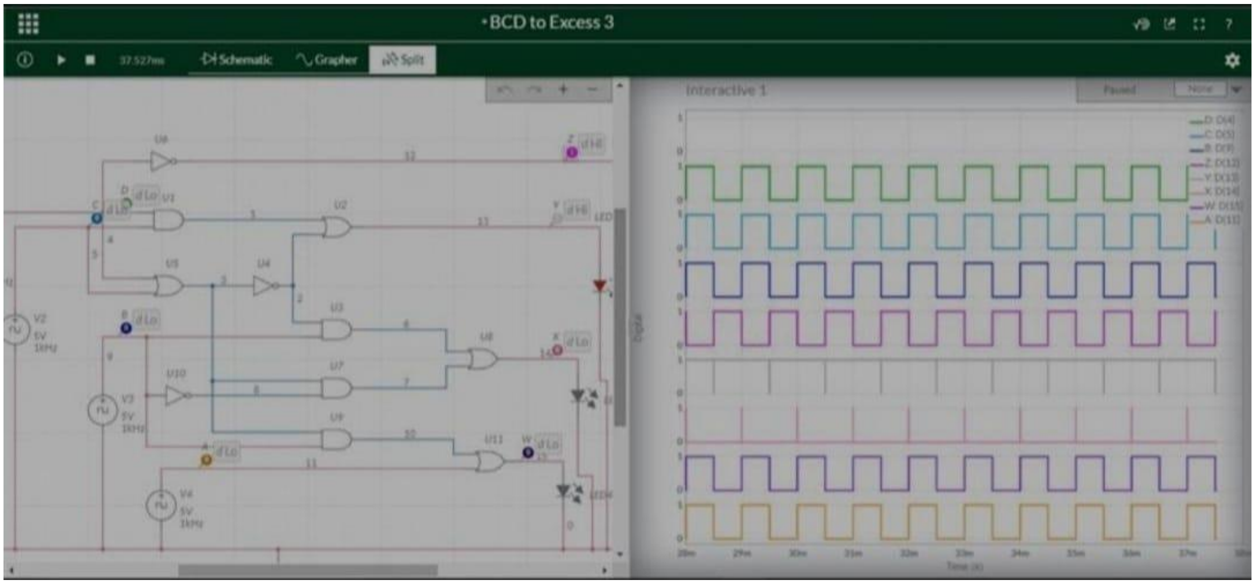
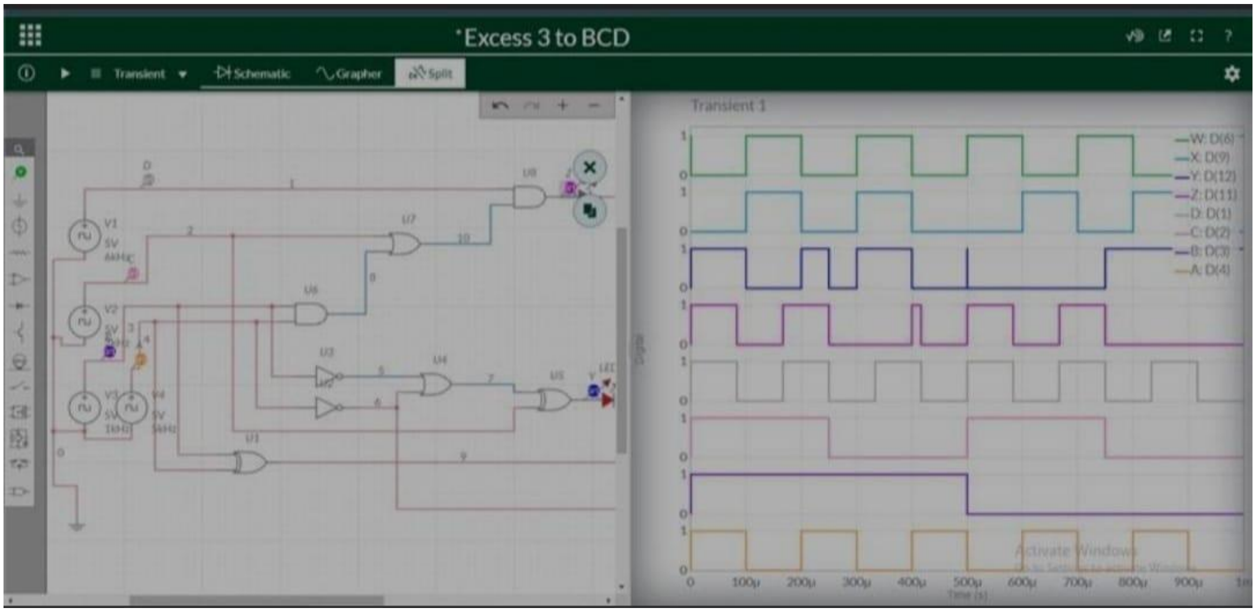
So, $(101110001100)_{Excess-3} = (100001011001)_{BCD}$

BCD TO EXCESS 3 CONVERTOR : **CIRCUIT/CONNECTION DIAGRAMS (FROM MULTISIM)**



ASSIGNMENT :

EXCESS 3 TO BCD CONVERTOR : CIRCUIT/CONNECTION DIAGRAMS (FROM MULTISIM)



CONCLUSION:

THE TRUTH TABLE IN THEORY AND THE SIMULATION OF BCD TO EXCESS 3 AND EXCESS 3 TO BCD CIRCUIT ON MULTISIM LIVE BOTH ARE EQUAL. HENCE, VERIFIED…