DIGITAL LOGIC

LECTURE-19

Code conversion

- The availability of a large variety of codes for the same discrete elements of information results in the use of different codes by different digital systems.

- A conversion circuit must be inserted between the two systems if each uses different codes for the same information.

- Thus, a code converter is a circuit that makes the two systems compatible even though each uses a different binary code.

- To convert from binary code A to binary code B, the input lines must supply the bit combination of elements as specified by code A and the output lines must generate the corresponding bit combination of code B. A combinational circuit performs this transformation by means of logic gates.

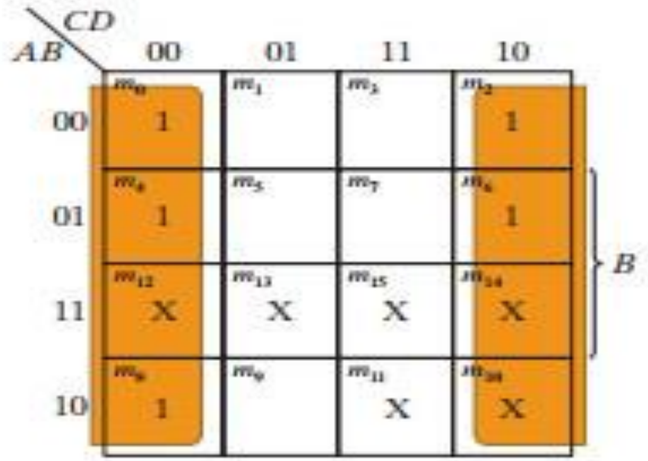
- The design procedure will be illustrated by an example that converts binary coded decimal (BCD) to the excess-3 code for the decimal digits.

Truth Table for Code Conversion Example

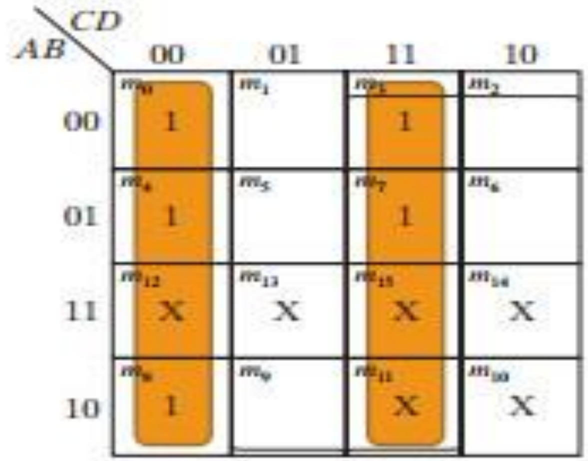
Input BCD				Output Excess-3 Code			
A	*B*	*C*	*D*	*w*	*x*	*y*	*z*
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0

We designate the four input binary variables by the symbols A, B, C, and D, and the four output variables by w, x, y , and z .

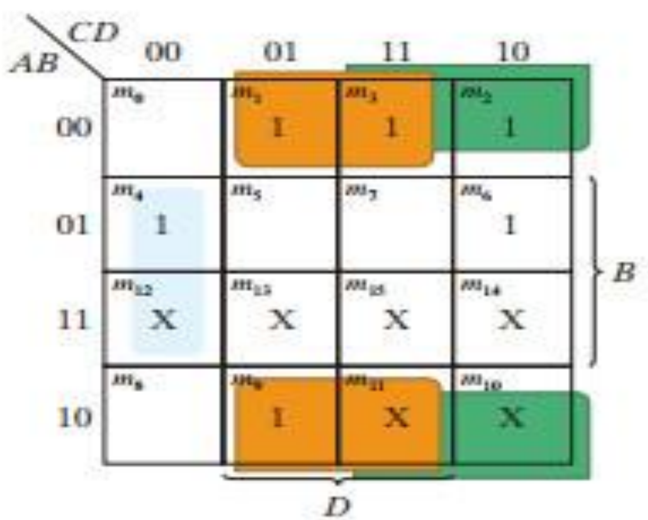
Maps for BCD-to-excess-3 code converter



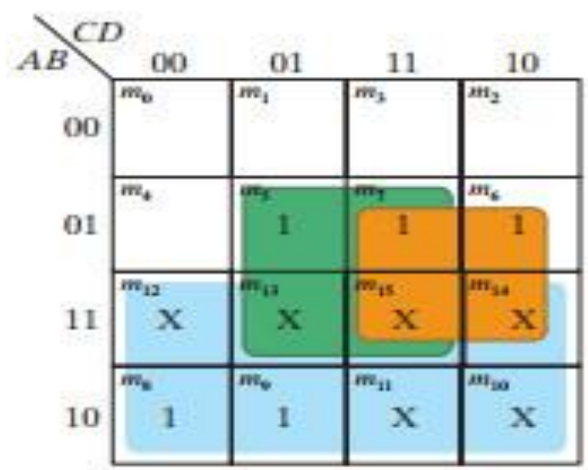
$z = D'$



$y = CD + C'D'$



$x = B'C + B'D + BC'D'$



$w = A + BC + BD$

So, finally the output expression are as follows:

$$z = D'$$

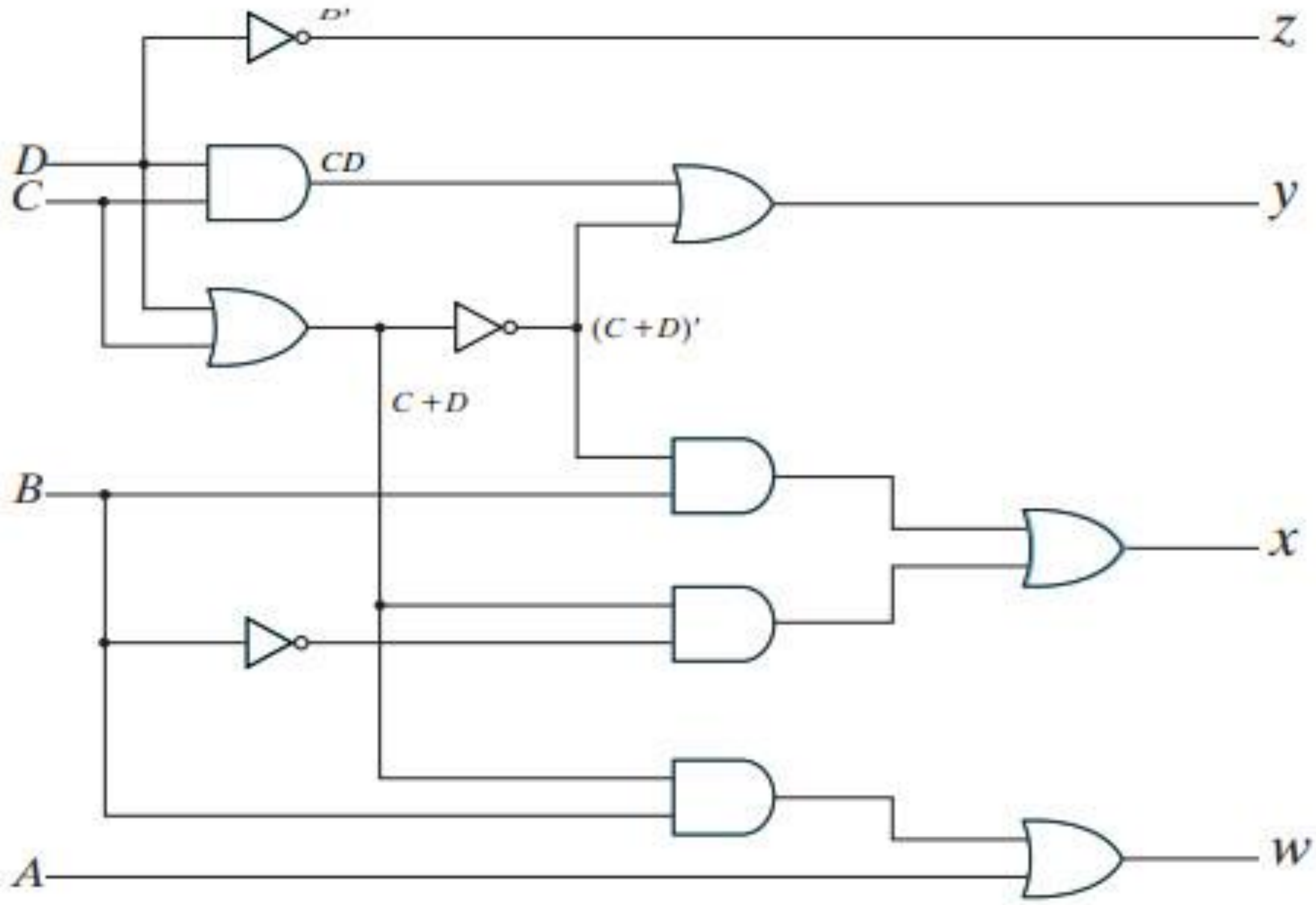
$$y = CD + C'D' = CD + (C + D)'$$

$$x = B'C + B'D + BC'D' = B'(C + D) + BC'D'$$

$$= B'(C + D) + B(C + D)'$$

$$w = A + BC + BD = A + B(C + D)$$

Logic diagram for BCD-to-excess-3 code converter



Design a combinational circuit that converts a four-bit binary number **to a four bit Gray code .**

The gray code is a non-weighted code. The successive gray code differs in one-bit position only that means it is a unit distance code. It is also referred as a cyclic code. It is not suitable for arithmetic operations. It is the most popular of the unit distance codes. It is also a reflective code. An n-bit Gray code can be obtained by reflecting an n-1 bit code about an axis after 2n-1 rows and putting the MSB of 0 above the axis and the MSB of 1 below the axis. Reflection of the 4 bits binary to gray code conversion table is given below:

The Truth Table for binary –Gray Code Convertor Circuit

Decimal Number	4 bit Binary Number ABCD	4 bit Gray Code $G_1G_2G_3G_4$
0	0 0 0 0	0 0 0 0
1	0 0 0 1	0 0 0 1
2	0 0 1 0	0 0 1 1
3	0 0 1 1	0 0 1 0
4	0 1 0 0	0 1 1 0
5	0 1 0 1	0 1 1 1
6	0 1 1 0	0 1 0 1
7	0 1 1 1	0 1 0 0
8	1 0 0 0	1 1 0 0
9	1 0 0 1	1 1 0 1
10	1 0 1 0	1 1 1 1
11	1 0 1 1	1 1 1 0
12	1 1 0 0	1 0 1 0
13	1 1 0 1	1 0 1 1
14	1 1 1 0	1 0 0 1
15	1 1 1 1	1 0 0 0

AB \ CD	00	01	11	10
00	$_{0}$	$_{1}$	$_{3}$	$_{2}$
01	$_{4}$	$_{5}$	$_{7}$	$_{6}$
11	1 $_{12}$	1 $_{13}$	1 $_{15}$	1 $_{14}$
10	1 $_{8}$	1 $_{9}$	1 $_{11}$	1 $_{10}$

$G_4 = A$

AB \ CD	00	01	11	10
00	$_{0}$	$_{1}$	$_{3}$	$_{2}$
01	1 $_{4}$	1 $_{5}$	1 $_{7}$	1 $_{6}$
11	$_{12}$	$_{13}$	$_{15}$	$_{14}$
10	1 $_{8}$	1 $_{9}$	1 $_{11}$	1 $_{10}$

$G_3 = \bar{A}B + A\bar{B} = A \oplus B$

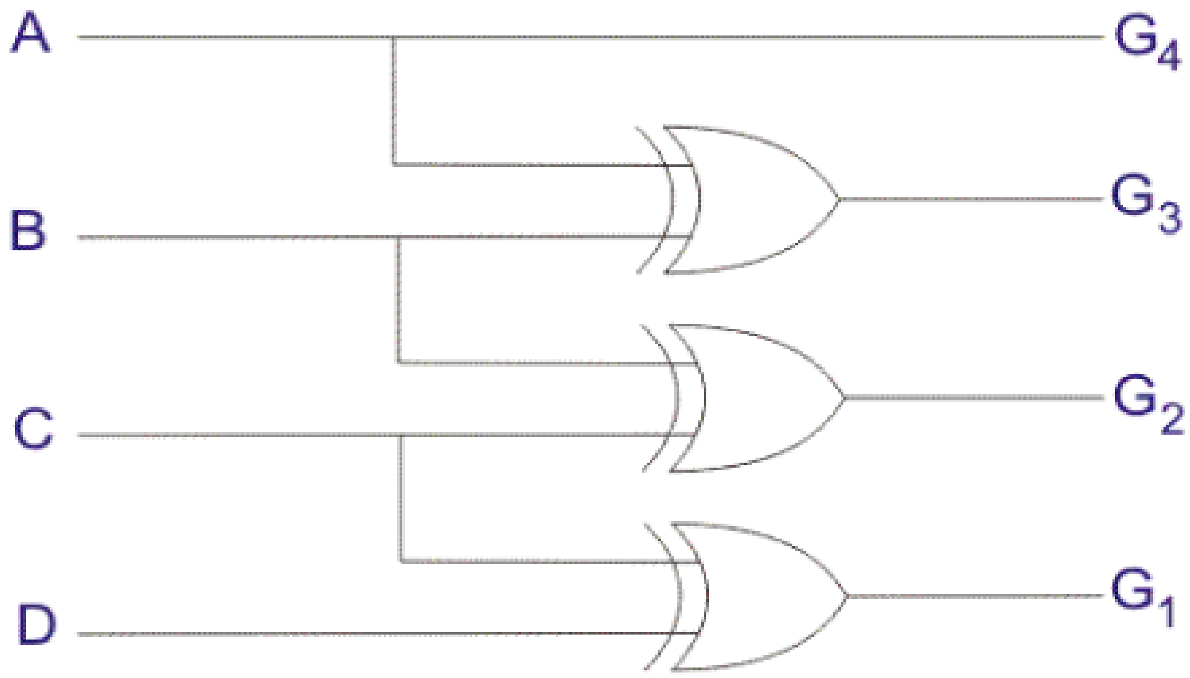
AB \ CD	00	01	11	10
00	$_{0}$	$_{1}$	1 $_{3}$	1 $_{2}$
01	1 $_{4}$	1 $_{5}$	$_{7}$	$_{6}$
11	1 $_{12}$	1 $_{13}$	$_{15}$	$_{14}$
10	$_{8}$	$_{9}$	1 $_{11}$	1 $_{10}$

$G_2 = B\bar{C} + \bar{B}C = B \oplus C$

AB \ CD	00	01	11	10
00	$_{0}$	1 $_{1}$	$_{3}$	1 $_{2}$
01	$_{4}$	1 $_{5}$	$_{7}$	1 $_{6}$
11	$_{12}$	1 $_{13}$	$_{15}$	1 $_{14}$
10	$_{8}$	1 $_{9}$	$_{11}$	1 $_{10}$

$G_1 = \bar{C}D + C\bar{D} = C \oplus D$

Logic Diagram for Binary – Gray Code Convertor



Design a code converter that converts a decimal digit from "8, 4, –2, –1" code to BCD.

The Truth Tabl

	8	4	-2	-1	8	4	2	1
	A	B	C	D	w	x	y	z
0	0	0	0	0	0	0	0	0
1	0	1	1	1	0	0	0	1
2	0	1	1	0	0	0	1	0
3	0	1	0	1	0	0	1	1
4	0	1	0	0	0	1	0	0
5	1	0	1	1	0	1	0	1
6	1	0	1	0	0	1	1	0
7	1	0	0	1	0	1	1	1
8	1	0	0	0	1	0	0	0
9	1	1	1	1	1	0	0	1

C

A

AB\CD	00	01	11	10
00		X	X	X
01				
11	X	X	1	X
10	1			

w = AB + AC′D′

C

A

AB\CD	00	01	11	10
00		X	X	X
01	1			
11	X	X		X
10		1	1	1

x = B′C + B′D + BC′D′

C

A

AB\CD	00	01	11	10
00		X	X	X
01		1		1
11	X	X		X
10		1		1

y = C′D + CD′

and z = D

THANK YOU