

#Design 3 bit Gray Code to binary converters

Ans. The truth table for 3 bit Gray Code to binary conversion is as shown:

Decimal Equipment	Gray Code			Binary Code		
	G_2	G_1	G_0	B_2	B_1	B_0
0	0	0	0	0	0	0
1	0	0	1	0	0	1
3	0	1	1	0	1	0
2	0	1	0	0	1	1
6	1	1	0	1	0	0
7	1	1	1	1	0	1
5	1	0	1	1	1	0
4	1	0	0	1	1	1

K-Maps:

For B2:

		$G_1 G_0$			
		$\bar{G}_1 \bar{G}_0$	$\bar{G}_1 G_0$	$G_1 \bar{G}_0$	$G_1 G_0$
G_2	\bar{G}_2	0 ₀	0 ₁	0 ₃	0 ₂
	G_2	1 ₄	1 ₅	1 ₇	1 ₆

$\therefore B_2 = G_2$

For B1:

		$G_1 G_0$			
		$\bar{G}_1 \bar{G}_0$	$\bar{G}_1 G_0$	$G_1 \bar{G}_0$	$G_1 G_0$
G_2	\bar{G}_2	0 ₀	0 ₁	1 ₃	1 ₂
	G_2	1 ₄	1 ₅	0 ₇	0 ₆

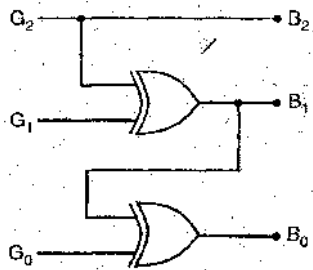
$\therefore B_1 = \bar{G}_2 G_1 + G_2 \bar{G}_1$
 $B_1 = G_1 \oplus G_2$

For B0:

		$G_1 G_0$			
		$\bar{G}_1 \bar{G}_0$	$\bar{G}_1 G_0$	$G_1 \bar{G}_0$	$G_1 G_0$
G_2	\bar{G}_2	0 ₀	1 ₁	0 ₃	1 ₂
	G_2	1 ₄	0 ₅	1 ₇	0 ₆

$\therefore B_0 = \bar{G}_2 \bar{G}_1 G_0 + \bar{G}_2 G_1 \bar{G}_0 +$
 $G_2 \bar{G}_1 \bar{G}_0 + G_2 G_1 G_0$
 $= \bar{G}_2 (\bar{G}_1 G_0 + G_1 \bar{G}_0) + G_2 (\bar{G}_1 \bar{G}_0 + G_1 G_0)$
 $= \bar{G}_2 (G_1 \oplus G_0) + G_2 (G_1 \odot G_0)$
 $= \bar{G}_2 (G_1 \oplus G_0) + G_2 (\overline{G_1 \oplus G_0})$
 $\therefore B_0 = G_1 \oplus G_0 \oplus G_2$

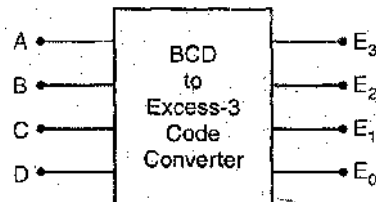
Circuit Implementation is as shown:



#Design BCD to Excess-3 code converter.

Ans. BCD to Excess-3 Code Converter:

The input variables are BCD's (A, B, C and D) and output variables are excess-3 code (E₃, E₂, E₁ and E₀)



Truth Table

Decimal	BCD				Excess - 3 code			
	A	B	C	D	E ₃	E ₂	E ₁	E ₀
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	1	1	1	0
4	0	1	0	0	0	1	1	1
5	0	1	0	1	0	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

After '9' i.e. 1001 BCD, mark don't care i.e. 'X'.

Minimization Using K-map:

For E3 ◊

		CD			
		$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
AB	$\bar{A}\bar{B}$	0	0	0	0
	$\bar{A}B$	0	1	1	1
	AB	X	X	X	X
	$A\bar{B}$	1	1	X	X

$$E3 = A + BD + BC$$

For E2 ◊

		CD			
		$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
AB	$\bar{A}\bar{B}$	0	1	1	1
	$\bar{A}B$	1	0	0	0
	AB	X	X	X	X
	$A\bar{B}$	0	1	X	X

$$E_2 = B\bar{C}\bar{D} + \bar{B}C + \bar{B}D$$

For E1 ◊

		CD			
		$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
AB	$\bar{A}\bar{B}$	1	0	1	0
	$\bar{A}B$	1	0	1	0
	AB	X	X	X	X
	$A\bar{B}$	1	0	X	X

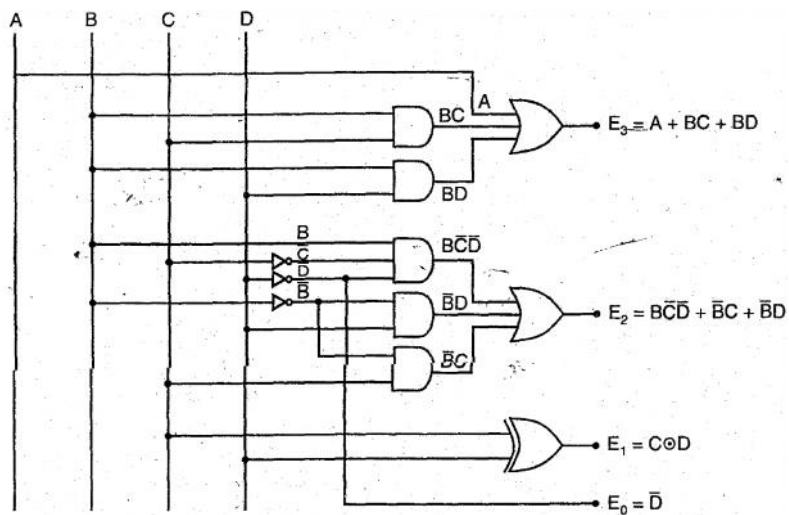
$$E_1 = \bar{C}\bar{D} + CD = C.D$$

For E0 ◊

		CD			
		$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
AB	$\bar{A}\bar{B}$	1	0	0	1
	$\bar{A}B$	1	0	0	1
	AB	X	X	X	X
	$A\bar{B}$	1	0	X	X

$$\therefore E_0 = \bar{D}$$

Implementation of Excess-3 Code Converter:



Assignment: Design 3 bit Binary to Gray Converter.