Paper 7, TDC Part-3
Chapter– 4, Combinational Logic Design
Lecture - 22

By:
Mayank Mausam
Assistant Professor (Guest Faculty)
Department of Electronics
L.S. College, BRA Bihar University,
Muzaffarpur, Bihar

Combinational Logic Design

Let us now obtain logical expression for B_2, B_1 & B_0

$G_3G_2 \backslash G_1G_0$	00	01	11	10
00				
01	1	1	1	1
11				
10	1	1	1	1

K-Map for B_2

Offset Adjacencies

Here there is 2 group of ones with 4 ones in each group. These 2 groups are in offset adjacencies so the expression for B_2 can expressed in EX-OR / ~~EX-NOR~~ operation

$$B_2 = \overline{G_3} G_2 + G_3 \overline{G_2} = G_3 \oplus G_2$$

Combinational Logic Design

$G_3G_2 \backslash G_1G_0$	00	01	11	10
00			1	1
01	1	1		
11			1	1
10	1	1		

Diagonal 1 (F_1)

Diagonal 2 (F_2)

Diagonal 4 (F_4)

Offset 2 (F_6)

Diagonal 3 (F_3)

K-Map for B, Offset 1 (F_5)

Diagonal 1, $F_1 = \overline{G_3}\,\overline{G_2}\,G_1 + \overline{G_3}\,G_2\,\overline{G_1} = \overline{G_3}(\overline{G_2}G_1 + G_2\overline{G_1})$
$= \overline{G_3}(G_2 \oplus G_1)$

Diagonal 2, $F_2 = \overline{G_3}\,G_2\,\overline{G_1} + G_3\,G_2\,G_1 = G_2(\overline{G_3}\,\overline{G_1} + G_3G_1)$
$= G_2(G_3 \odot G_1)$

Diagonal 3, $F_3 = G_3G_2G_1 + G_3\overline{G_2}\,\overline{G_1} = G_3(G_2G_1 + \overline{G_2}\,\overline{G_1})$
$= G_3(G_2 \odot G_1)$

Combinational Logic Design

Diagonal 4, $F_4 = \bar{G}_3 \bar{G}_2 \bar{G}_1 + G_3 \bar{G}_2 G_1$

$= \bar{G}_2 (\bar{G}_3 \bar{G}_1 + \bar{G}_3 G_1)$

$= \bar{G}_2 (G_3 \oplus G_1)$

Offset 1, $F_5 = \bar{G}_3 \bar{G}_2 \bar{G}_1 + G_3 \bar{G}_2 \bar{G}_1 = \bar{G}_1 (\bar{G}_3 G_2 + G_3 \bar{G}_2)$

$= \bar{G}_1 (G_3 \oplus G_2)$

Offset 2, $F_6 = \bar{G}_3 \bar{G}_2 G_1 + G_3 G_2 G_1 = G_1 (\bar{G}_3 \bar{G}_2 + G_3 G_2)$

$= G_1 (G_3 \odot G_2)$

Now the expression for B_1 can be written by considering either (Diagonal 1 & Diagonal 3) or (Diagonal 2 & Diagonal 4) or (Offset 1, Offset 2).

Combinational Logic Design

$B_1 = \text{Diagonal } 2\,(F_2) + \text{Diagonal } 4\,(F_4)$

$B_1 = G_2(G_3 \odot G_1) + \overline{G_2}\,(G_3 \oplus G_1)$

$B_1 = G_2 \oplus G_3 \oplus G_1$

$G_3G_2 \backslash G_1G_0$	00	01	11	10
00		1	0	1
01	1		1	
11		1		1
10	1		1	

Diagonal 1 F_1

Diagonal 3, F_3

Diagonal 2 F_2

Diagonal 4, F_4

K-Map for B_0

Combinational Logic Design

Diagonal 1, $F_1 = \bar{G}_3 \bar{G}_2 \bar{G}_1 G_0 + \bar{G}_3 G_2 \bar{G}_1 \bar{G}_0$

$= \bar{G}_3 \bar{G}_1 (G_2 G_0 + G_2 \bar{G}_0) = \bar{G}_3 \bar{G}_1 (\bar{G}_2 G_0 + G_2 \bar{G}_0)$

$= \bar{G}_3 \bar{G}_1 (G_2 \oplus G_0)$

Diagonal 2, $F_2 = G_3 G_2 \bar{G}_1 G_0 + G_3 \bar{G}_2 \bar{G}_1 \bar{G}_0$

$= G_3 \bar{G}_1 (G_2 G_0 + \bar{G}_2 \bar{G}_0) = G_3 \bar{G}_1 (G_2 \odot G_0)$

Diagonal 3, $F_3 = \bar{G}_3 \bar{G}_2 G_1 \bar{G}_0 + \bar{G}_3 G_2 G_1 G_0$

$= \bar{G}_3 G_1 (\bar{G}_2 \bar{G}_0 + G_2 G_0)$

$= \bar{G}_3 G_1 (G_2 \odot G_0)$

Combinational Logic Design

Diagonal 4, $F_4 = G_3 G_2 G_1 \bar{G}_0 + G_3 \bar{G}_2 G_1 G_0$

$$= G_3 G_1 (G_2 \bar{G}_0 + \bar{G}_2 G_0)$$

$$= G_3 G_1 (G_2 \oplus G_0)$$

$B_0 = F_1 + F_2 + F_3 + F_4$

$$= \bar{G}_3 \bar{G}_1 (G_2 \oplus G_0) + G_3 \bar{G}_1 (G_2 \odot G_0) + \bar{G}_3 G_1 (G_2 \odot G_0) + G_3 G_1 (G_2 \oplus G_0)$$

$$B_0 = (G_2 \oplus G_0)(\bar{G}_3 \bar{G}_1 + G_3 G_1) + (G_2 \odot G_0)(G_3 \bar{G}_1 + \bar{G}_3 G_1)$$

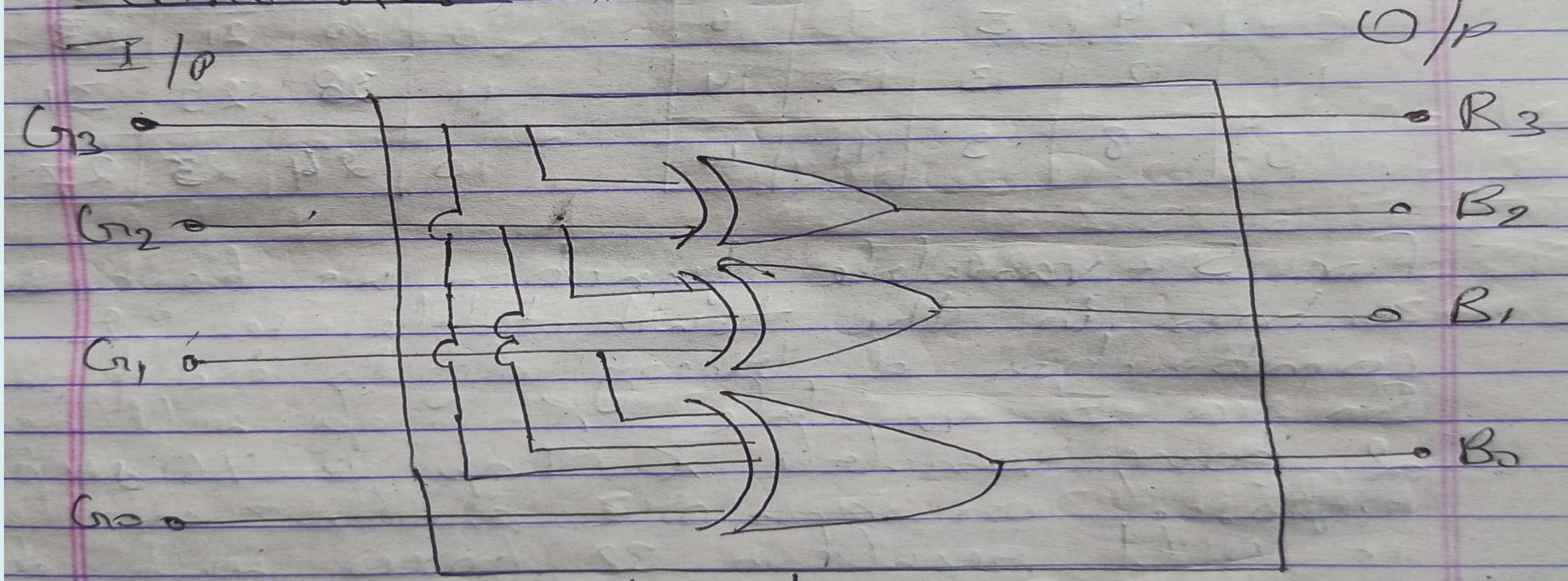
$$B_0 = (G_2 \oplus G_0)(G_3 \odot G_1) + (G_2 \odot G_0)(G_3 \oplus G_1)$$

Combinational Logic Design

$$B_0 = (G_2 \oplus G_0)\overline{(G_3 \oplus G_1)} + \overline{(G_2 \oplus G_0)}(G_3 \oplus G_1)$$

$$= (G_2 \oplus G_0) \oplus (G_3 \oplus G_1) = G_3 \oplus G_2 \oplus G_1 \oplus G_0$$

Ckt Diagram for Gray to Binary Code Converter is drawn below



4-bit Gray to 4-bit Binary Code Converter

Combinational Logic Design

Refer book- Modern Digital Electronics by RP Jain.

Thank You