PROBLEMS

1.Design a Gray-to Excess-3 Code converter using NAND gates

Ans. Gray to Excess3 code converter:

Decimal	Binary Equivalent			Gray Code			Excess-3 Code			
				G_2	G_1	G_0	E_3	E_2	E_1	E_0
0	0	0	0	0	0	0	0	0	1	1
1	0	0	1	0	0	1	0	1	0	0
2	0	1	0	0	1	1	0	1	0	1
3	0	1	1	0	1	0	0	1	1	0
4	1	0	0	1	1	0	0	1	1	1
5	1	0	1	1	1	1	1	0	0	0
6	1	1	0	1	0	1	1	0	0	1
7	1	1	1	1	0	0	1	0	1	0

K-maps for Excess 3-codes are

For $E_3 \rightarrow$

G_2 \ G_1G_0	$\bar{G}_1\bar{G}_0$	$\bar{G}_1G_0$	G_1G_0	$G_1\bar{G}_0$
$\bar{G}_2$	0	0	0	0
G_2	1	1	1	0

$\therefore \quad E_3 = G_2\bar{G}_1 + G_2G_0$

For $E_2 \rightarrow$

G_2 \ G_1G_0	$\bar{G}_1\bar{G}_0$	$\bar{G}_1G_0$	G_1G_0	$G_1\bar{G}_0$
$\bar{G}_2$	0	1	1	1
G_2	0	0	0	1

$\therefore \quad E_2 = \bar{G}_2G_0 + G_1\bar{G}_0$

For $E_1 \rightarrow$

G_2 \ G_1G_0	$\bar{G}_1\bar{G}_0$	$\bar{G}_1G_0$	G_1G_0	$G_1\bar{G}_0$
$\bar{G}_2$	1	0	0	1
G_2	1	0	0	1

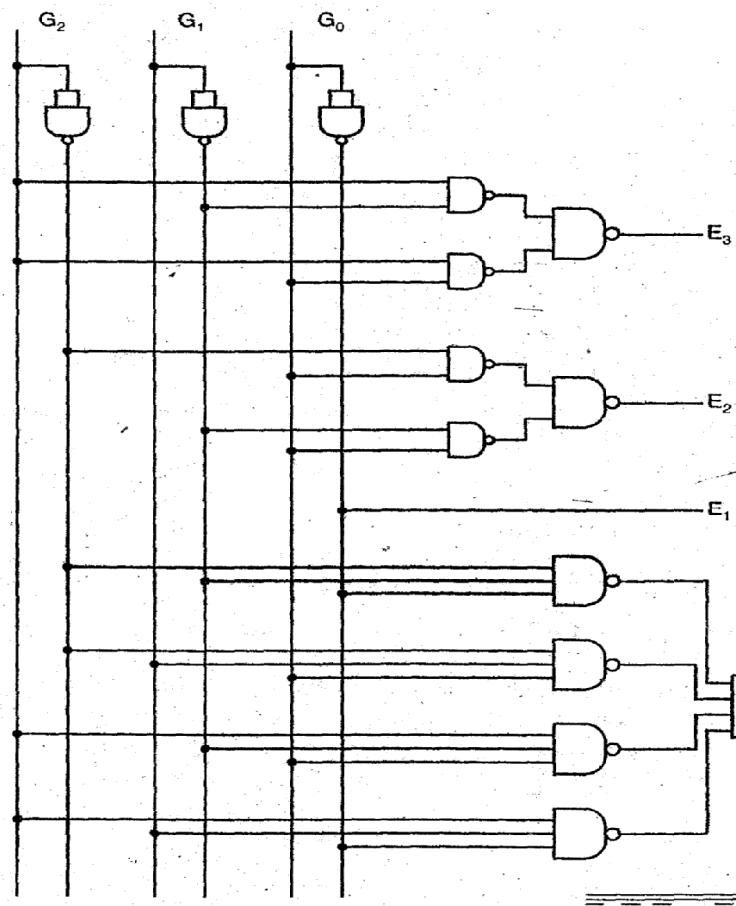
$\therefore \quad E_1 = \bar{G}_0$

For $E_0 \rightarrow$

G_2 \ G_1G_0	$\bar{G}_1\bar{G}_0$	$\bar{G}_1G_0$	G_1G_0	$G_1\bar{G}_0$
$\bar{G}_2$	(1)	0	(1)	0
G_2	0	(1)	0	(1)

$\therefore \quad E_0 = \bar{G}_2\bar{G}_1\bar{G}_0 + \bar{G}_2G_1G_0 + G_2\bar{G}_1G_0 + G_2G_1\bar{G}_0$

Circuit Diagram:



$$E_3 = \overline{\bar{G}_2\bar{G}_1 + G_2G_0} = \overline{\left(\bar{G}_2\bar{G}_1\right)\left(\overline{G_2G_0}\right)}$$

$$E_2 = \overline{\bar{G}_2G_0 + G_1\bar{G}_0} = \overline{\left(\overline{\bar{G}_2G_0}\right)\left(\overline{G_1\bar{G}_0}\right)}$$

$$E_1 = \bar{G}_0$$

$$E_0 = \overline{\bar{G}_2\bar{G}_1\bar{G}_0 + \bar{G}_2G_1G_0 + G_2\bar{G}_1G_0 + G_2G_1\bar{G}_0} = \overline{\left(\overline{\bar{G}_2\bar{G}_1\bar{G}_0}\right)\left(\overline{\bar{G}_2G_1G_0}\right)\left(\overline{G_2\bar{G}_1G_0}\right)\left(\overline{G_2G_1\bar{G}_0}\right)}$$

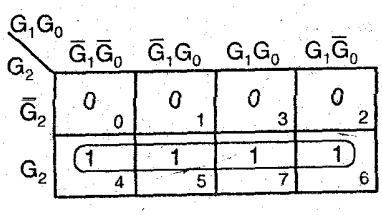
3. Design 3 bit Gray Code to binary converters

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

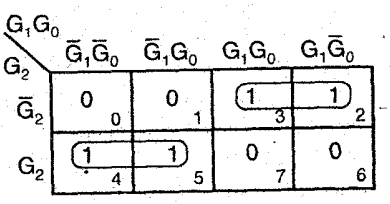
K-Maps:

For 82:



$\therefore B_2 = G_2$

For B1:



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

$B_1 = G_1 \oplus G_2$

For Bo:

G_2 \ G_1G_0	$\bar{G}_1\bar{G}_0$	$\bar{G}_1G_0$	G_1G_0	$G_1\bar{G}_0$
$\bar{G}_2$	0 (0)	1 (1)	0 (3)	1 (2)
G_2	1 (4)	0 (5)	1 (7)	0 (6)

$$\therefore B_0 = \bar{G}_2\bar{G}_1G_0 + \bar{G}_2G_1\bar{G}_0 + G_2\bar{G}_1\bar{G}_0 + G_2G_1G_0$$

$$= \bar{G}_2\left(\bar{G}_1G_0 + G_1\bar{G}_0\right) + G_2\left(\bar{G}_1\bar{G}_0 + G_1G_0\right)$$

$$= \bar{G}_2\left(G_1 \oplus G_0\right) + G_2\left(G_1 \odot G_0\right)$$

$$= \bar{G}_2\left(G_1 \oplus G_0\right) + G_2\left(\overline{G_1 \oplus G_0}\right)$$

$$\therefore B_0 = G_1 \oplus G_0 \oplus G_2.$$

Circuit Implementation is as shown: