4-bit Binary to Gray Code Converter:

A binary to Gray code converter is a circuit that transforms binary numbers into Gray code, a non-weighted, cyclic binary numeral system where each successive value differs by only one bit. This unit distance property minimizes errors in digital systems. However, Gray code is not suitable for arithmetic operations. An n-bit Gray code can be generated by reflecting an (n-1)-bit code and prefixing the reflected sequence with a 1, while the original sequence is prefixed with a 0. Reflection of the 4 bits binary to gray code conversion table is given below:

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

Now from the conversion table

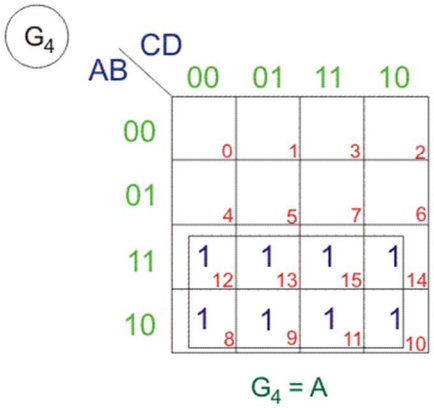
$G4=\sum m(8,9,10,11,12,13,14,15)$,

$G3=\sum m(4,5,6,7,8,9,10,11)$

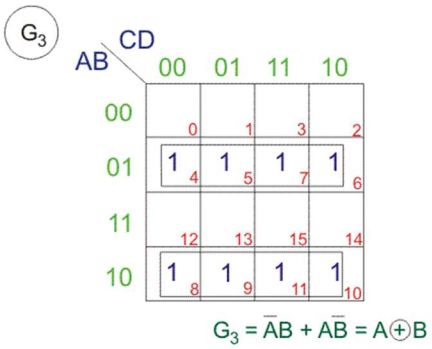
$G2=\sum m(2,3,4,5,10,11,12,13)$,

$G1=\sum m(1,2,5,6,9,10,13,14)$

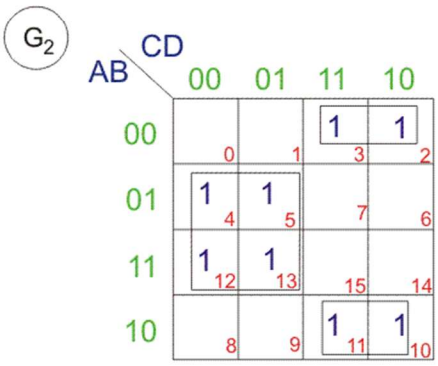
From above SOPs, let us draw K-maps for G4, G3, G2 and G1.



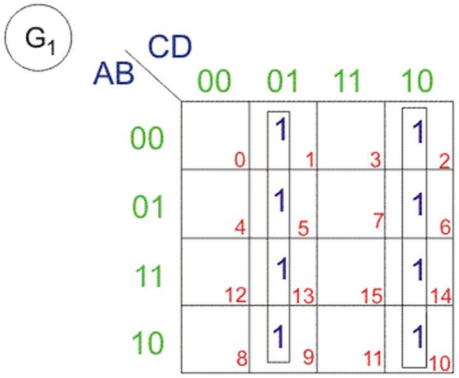
$G_4 = A$



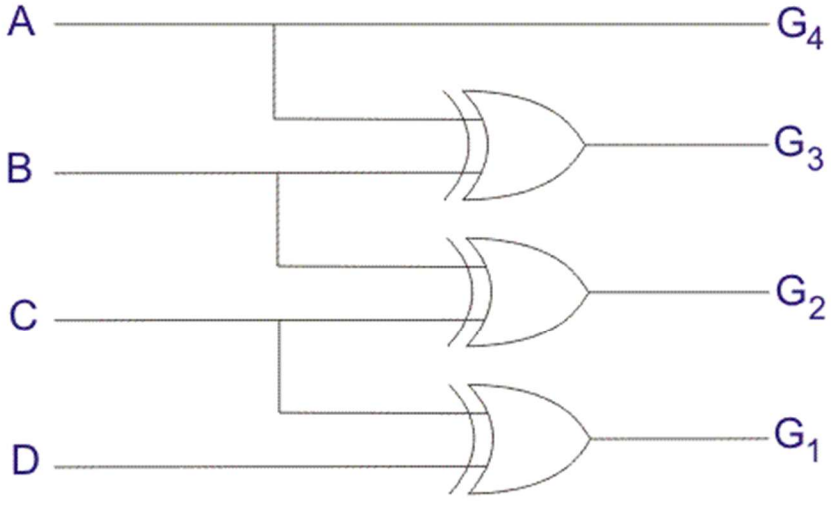
$G_3 = A\bar{B} + \bar{A}B = A \oplus B$



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



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



Logic Circuit for Binary to Gray Code Converter

Simulation Outputs & Waveforms:

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Binary Input = 0000 | Gray Output = 0000
Binary Input = 0001 | Gray Output = 0001
Binary Input = 0010 | Gray Output = 0011
Binary Input = 0011 | Gray Output = 0010
Binary Input = 0100 | Gray Output = 0110
Binary Input = 0101 | Gray Output = 0111
Binary Input = 0110 | Gray Output = 0101
Binary Input = 0111 | Gray Output = 0100
Binary Input = 1000 | Gray Output = 1100
Binary Input = 1001 | Gray Output = 1101
Binary Input = 1010 | Gray Output = 1111
Binary Input = 1011 | Gray Output = 1110
Binary Input = 1100 | Gray Output = 1010
Binary Input = 1101 | Gray Output = 1011
Binary Input = 1110 | Gray Output = 1001
Binary Input = 1111 | Gray Output = 1000
```