Q. Find the Hamming code for 1011.

sol.

let the 1st, 2nd, 3rd and a 4th bit from the left side of data be m1, m2, m3, and m4.

Total number of data bits m = 4

Total number of redundant bits 'r' will be:

$$2^r \geq m + r + 1$$

For r = 1:

$$2^1 \geq 4 + 1 + 1$$

⇨ $2 \geq 6$ $(\boldsymbol{not\ true})$

For r = 2:

$$2^2 \geq 4 + 2 + 1$$

⇨ $4 \geq 7$ $(\boldsymbol{not\ true})$

For r = 3:

$$2^3 \geq 4 + 3 + 1$$

⇨ $8 \geq 8$ $(\boldsymbol{true})$

So, the total number of redundant bits will be 3.Therefore, total length of Hamming code will be 4 + 3 = 7 bits

Let the redundant bits be name as r0, r1 and r2

So, position of r0 = 2^0 = 1

position of r1 = 2^1 = 2

position of r2 = 2^2 = 4

The Hamming code will look like this:

r0	**r1**	**m1**	**r2**	**m2**	**m3**	**m4**
1	2	3	4	5	6	7

Fig. 1.1 model of hamming code for hamming (4,7)

After putting the values of m1, m2, m3 and m4 from data bits:

r0	**r1**	**1**	**r2**	**0**	**1**	**1**
1	2	3	4	5	6	7

Fig. 1.2 model of hamming code for Hamming (4,7) with data bits

Now, we need to find the values of r0, r1 and r2. For that lets make a table decimal to binary conversion table from 1 to 7.

1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

For r2 For r1 For r0

Note: We are taking Even parity.

For r0:

Check for the numbers in the above table, which has ‘1’ at the most significant bit i.e. the last bit form left.

we can see that 1,3,5 and 7 has ‘1’ at most significant bit.

Copy the values at the positions 1,3,5 and 7 from fig 1.2.

Therefore, we have: **r0 1 0 1**

Since, for even parity, number of 1’s should be even and we have even number of 1’s.

Therefore, **r0 = 0**

For r1:

Check for the numbers in the above table, which has ‘1’ at the 2nd bit form left.

we can see that 2,3,6 and 7 has ‘1’ at 2nd bit position.

Copy the values at the positions 2,3,6 and 7 from fig 1.2.

Therefore, we have: **r1 1 1 1**

Since, for even parity, number of 1’s should be even and we have odd number of 1’s.

Therefore, **r1 = 1**

For r2:

Check for the numbers in the above table, which has ‘1’ at the first bit form left.

we can see that 4,5,6 and 7 has ‘1’ at first bit position.

Copy the values at the positions 4,5,6 and 7 from fig 1.2.

Therefore, we have: **r2 0 1 1**

Since, for even parity, number of 1’s should be even and we have even number of 1’s.

Therefore, **r2 = 0**

Therefore, The Hamming code is:

0	1	1	0	0	1	1

Or, The Hamming code for 1011 is 0110011