# LAB REPORT-8

# DETERMINING ERROR CORRECTION CAPABILITY OF GIVEN (N,K) CODE USING HAMMING BOUND

**AIM:**

to determine the error correction capability of given (n,k) codeusing hamming code.

**THEORY:**

Hamming code is an error correction system that can detect and correct errors when data is stored or transmitted. It requires adding additional parity bits with the data. It is commonly used in error correction code (ECC) RAM. It's named after its inventor, Richard W. Hamming.

Whenever data is transmitted or stored, it's possible that the data may become corrupted. This can take the form of bit flips, where a binary 1 becomes a 0 or vice versa. Error correcting codes seek to find when an error is introduced into some data. This is done by adding parity bits, or redundant information, to the data.The number of redundant bits can be calculated using the following formula:

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

where, r = redundant bit, m = data bit

Hamming code is an error correction system that can detect and correct errors when data is stored or trans- mitted. It requires adding additional parity bits with the data. It is commonly used in error correction code (ECC). Hamming code uses a block parity mechanism. The data is dividedinto blocks, and parity is added to the block. Hamming code can correct single-bit errors and detect the presence of two-bit errors in a data block.

Binary single error correcting perfect codes are called Hamming codes.Consider (n, k) linear block code that has following parameters

- Block length n = 2^q - 1
- Number of message bits k = 2^q – q - 1
- Number of parity bits q = (n-k)
- Where q ≥ 3. This code is called Hamming code.

All single error-correcting linear block codes are hamming codes and in general given as:

$$c(n, k) = (2^P - 1, 2^P - 1 - P)$$

: $2^P - 1 = n$
$2^P - 1 - P = k$

## Hamming bound:

The Hamming Bound equation demonstrates these competing principals concisely. The equation is shown in figure five, where |C| is the upper bound number of codewords, n is the length of the code words, and k is the maximum number of errors it is capable of correcting. Any code that achieves the upper bound of the equation is known as a Perfect Code. As a side note, Richard Hamming developed a perfect code known now as Hamming Codes.

Hamming Bound

$$|C| \leq \frac{2^n}{\sum_{i=0}^{k}\binom{n}{i}}$$

*Figure 5*

# CODE:

```
%Code for Hamming bound

clc;

clear all;

close all;

n=input('énter the code word length : n :');

k=input('énter the message bits: k :');

m=n-k
```

```
z=2^m

i=0;

for j=0:1:n

  sum=0;

  for i=0:1:j

    c=factorial(n)/(factorial(n-1)*factorial(i));sum=sum+c;

  end

  if sum >= z

    j=j-1;

    sum=sum-c;

    break;

  end

end

 ans = sprintf('(%d,%d) can correct all combinations of %d errors and it
can also correct %d combinations of %d errors', n,k,j,z-sum,j+1);

 ans
```

## OUTPUT:

```
Command Window
enter the code bits:n: 7
enter the data bits:k: 4
3
8
(7,4) can correct all combinations of 0 errors and it can also correct 7 combinations of 1 erros
>> |
```

# CONCLUSION:

We have learnt about Hamming bound theory and coding using Matlab.