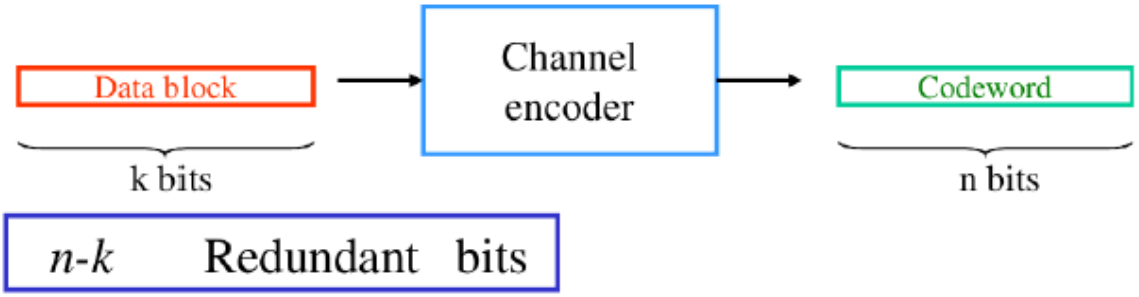
Name : Sudip Biswas
Roll: 2202035

Linear Block Codes

AIM:
To perform an experiment to simulate Linear Block Codes and Decode the linear block code.

Linear Block Codes



b = u * G
Where u is the input and G is Generator matrix

$$G = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{pmatrix}$$

G = (I | P)
Where I is identity matrix and P is parity check bit

Task

- **Write a matlab code to generate linear block code (7,4)**
    - Use generator matrix as

$$G = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{pmatrix}$$

    - For all 4-bit message sequences generate the 7-bit code sequence

Decode linear block code

For any linear code , we can find an matrix **H,** which its row are orthogonal to row G:

G H’ = 0

Where H is called the parity check matrix and its rows are linearly independent.

Syndrome testing
The syndrome testing is defined as

S = rH'

Where r is the received input from a noisy channel.

Task

- **Write a matlab code to detect message from linear block code**
    - Use generator matrix as

$$G = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{pmatrix}$$

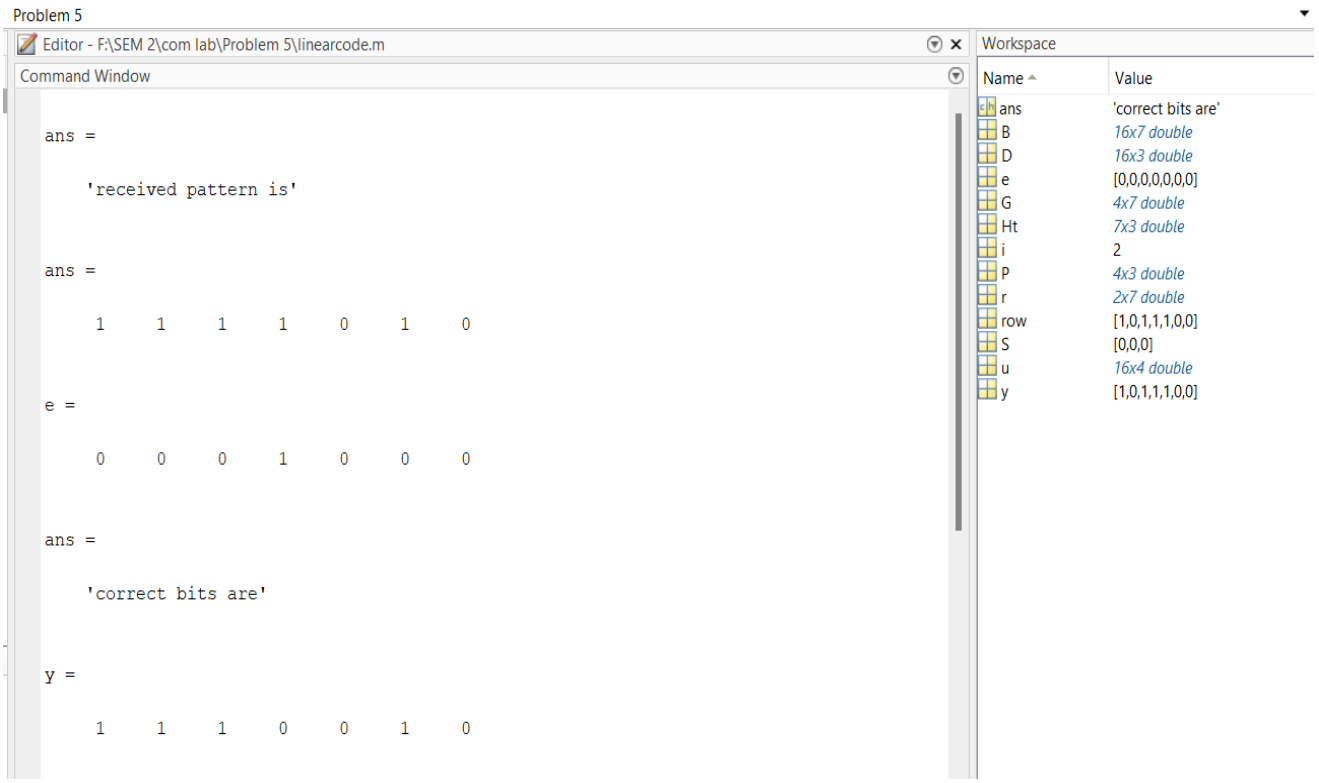
    - Perform s= rH'

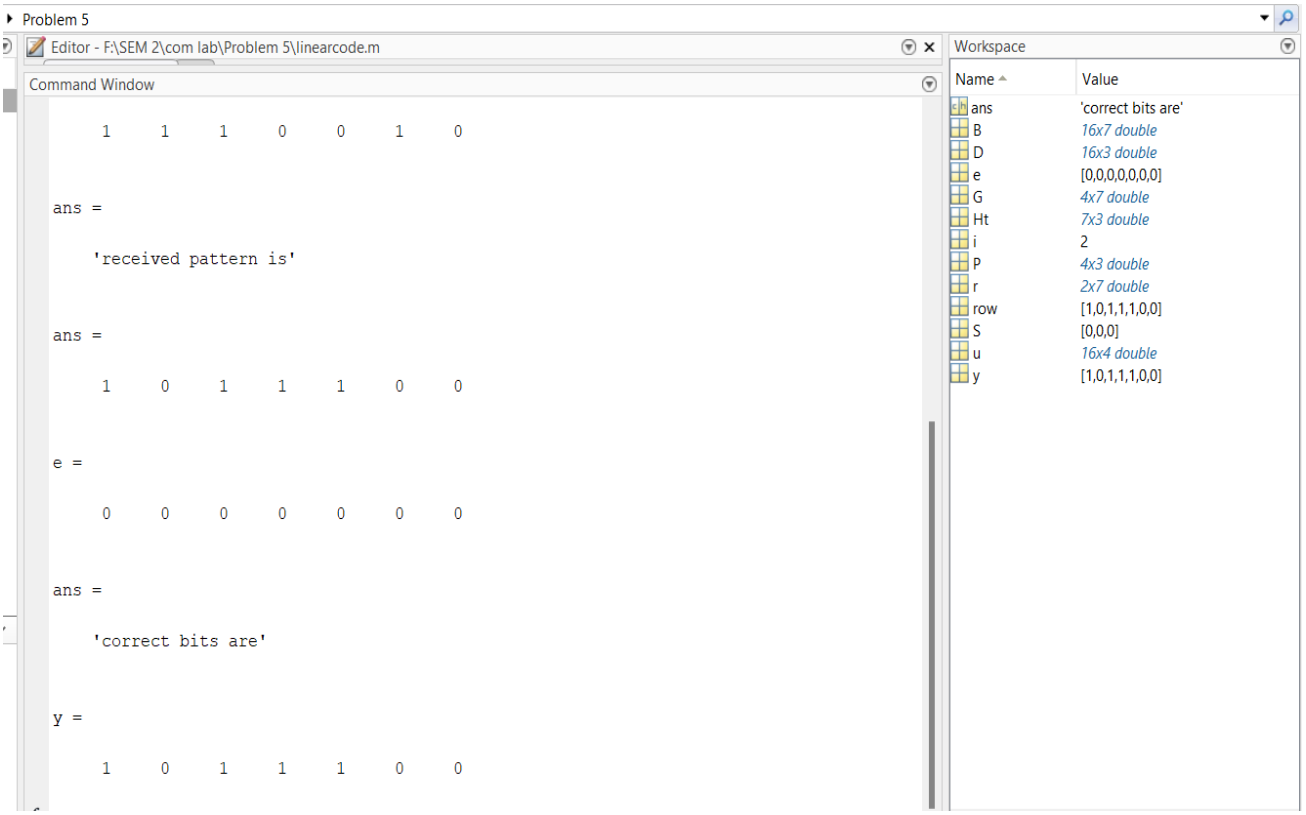
Working Code

```
%Task: Matlab code to generate linear block code (7,4)
clear all; close all; clc; % Clear all data
% Generator matrix  /systematic block code
P=[1 1 0; 0 1 1; 1 1 1; 1 0 1]; % P is parity matrix
G=[eye(4) P];
Ht = [P' eye(3)]';  % PARITY CHECK MATRIX
% array of input
u = [ [0 0 0 0];[0 0 0 1];[0 0 1 0];[0 0 1 1];[0 1 0 0];[0 1 0 1];
  [0 1 1 0];[0 1 1 1];[1 0 0 0];[1 0 0 1];[1 0 1 0];[1 0 1 1];[1 1 0 0];
  [1 1 0 1];[1 1 1 0];[1 1 1 1]];
% initialising the codeword output array
B = zeros(length(u),7);
% initialising the decoded output array
D = zeros(length(u),3);
% generate linear block code (7,4)
for i = 1:length(u)
  row = u(i,:);
  B(i,:) =mod(row * G,2);
end
% decoding syndrome of non error input coded from linear block code (7,4)
for i = 1:length(B)
  row = B(i,:);
  D(i,:) =mod(row * Ht,2);
end
% decoding syndrome of  error input coded from linear block code (7,4)
r = [[1 1 1 1 0 1 0];[1 0 1 1 1 0 0]];
for i = 1:2
  row = r(i,:);
  S =mod(row * Ht,2);
  if S==[0 0 0]
```

```
        e=[0 0 0 0 0 0 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(1,:)
        e=[0 0 0 0 0 0 1];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(2,:)
        e=[0 0 0 0 0 1 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(3,:)
        e=[0 0 0 0 1 0 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(4,:)
        e=[0 0 0 1 0 0 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(5,:)
        e=[0 0 1 0 0 0 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(6,:)
        e=[0 1 0 0 0 0 0];
        y=bitxor(r(i,:),e);
    end
    if S==Ht(7,:)
        e=[1 0 0 0 0 0 0];
        y=bitxor(r(i,:),e);
    end
    'received pattern is'
    r(i,:)
    'error pattern is';
    e
    'correct bits are'
    y
end
```

OUTPUT:





Observation :

- **Experiment to simulate Linear Block Codes is performed.**
- **Decoded the linear block code of given received bit and correct bit is found**