Problem 1

Given a linear binary code with the following generator matrix

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

What is the error vector belonging to the received vector $\mathbf{v} = (01011)$?

Problem 2

Given a linear binary code with generator matrix $\mathbf{G} = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 \end{pmatrix}$!

a) Give the type of the code *(n,k)* ?

b) Can this be a Hamming code?

c) How many errors can be detected and corrected by this code?

d) Can the error vectors $\mathbf{e}_1 = (10000)$ and $\mathbf{e}_2 = (00001)$ be distinguished?

e) Can these error vectors be group leaders?

f) If this code operates over a BSC with error probability $p = 0.2$ then what is the probability of these two error vectors occurring?

Problem 3

Given a linear binary code with parity check matrix $\mathbf{H} = (1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1)$!

a) Give the type of the code n, k !

b) Give the number of code words !

c) Give the minimum code distance $d_{\min}$!

d) Give the generator matrix **G**

Problem 4

Given a linear binary code with generator matrix $\mathbf{G} = \begin{pmatrix} 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \end{pmatrix}$!

a) Give the code parameters *n,k,d*

b) Give the standard arrangement table of the code!

c) Give the syndrome decoding table of the code!

d) Is this code MDS and Perfect?

e) Give the probability of a miss-decoding a code word if the channel is a memory free BSC!

Problem 5

Given a binary linear systematic code by the following codewords:

$$\mathbf{c}_0 = (000000);\ \mathbf{c}_1 = (011111);\ \mathbf{c}_2 = (101100);\ \mathbf{c}_3 = (110011)$$

a) Determine the syndrome vector belonging to error vector $\mathbf{e} = (011110)$!

b) What other error vectors are in the same error group !

c) What will be the group leader (the error vector appearing in teh syndrome decoding table from this group) ?

d) Calculate the probability of the group leader if the error probability of the BSC is P_b=0.1 !
