HW #1

1. Construct the prime field GF(5) with modulo-5 addition and multiplication. Find all the primitive elements and determine the order of the other elements.

2. Construct the vector space of all 3-tuples over GF(5). Form a two-dimensional subspace and its dual space.

HW#2

1. Show that $X^5 + X^3 + 1$ is irreducible over GF(2). You may use the statement "gfdeconv" in MATLAB to help.

2. Construct a table for GF(2^3) based on the primitive polynomial $P(X) = X^3 + X + 1$. Display the power, polynomial, and vector representations of each element. Determine the order of each element.

HW #3

1. Consider a systematic (8, 4) code whose parity-check equations are

$$v_0 = u_1 + u_2 + u_3$$

$$v_1 = u_0 + u_1 + u_2$$

$$v_2 = u_0 + u_1 + u_3$$

$$v_3 = u_0 + u_2 + u_3$$

   construct an encoder for the code.

2. Construct a syndrome circuit for the code given in Problem 1.

HW #4

1. In problem #1 in HW#3, show that the code has the minimum Hamming distance 4.

2. Find out all syndrome patterns in the above problem.

3. Determine the weight distribution of (8,4) linear code (mentioned in problem #1 in HW#3). Let the transition probability of a BSC be $p = 10^{-2}$. Compute the probability of an undetected error of this code.

HW #4-1

1. In the previous MATLAB program, we encode each Chinese character with Hamming encoding.

2. Now, for some reason, we would like to encode this file "杜甫詩.txt" with Hamming encoding by the line-by-line way. Please modify this program and adjust the SNR such that there are no errors in the "decoded file".

3. What kind of the shortened Hamming code is used ?

HW #5

1. Consider the (15, 11) cyclic Hamming code generated by

$$g(X) = 1 + X + X^4$$

(a) Determine the parity polynomial $h(X)$.

(b) Given $c(X) = 1 + X^2$, then what is the output code sequence ?

2. Devise an encoder and a syndrome circuit for Problem 1.

HW #6

1. In Example 4.6, with the received sequence $\bar{r} = (1001010)$ please illustrate the decoding steps.

2. Devise a decoding circuit for (7, 3) Hamming code generated by $g(X) = (X + 1)(X^3 + X + 1)$. The decoding circuits corrects all the single error patterns and all the double-adjacent-error patterns.

HW #6-1

1. In the previous MATLAB program, we encode each Chinese character with a cyclic encoding.

2. Now, for some reason, we would like to encode this file "杜甫詩.txt" with cyclic encoding by the line-by-line way. And this code is with 2-error correction. Please modify this program and adjust the SNR such that there are no errors in the decoded file.

3. What kind of the shortened cyclic code is used ?

HW # 7

1. Find the generator matrix of RM(1, 3), and its code length, and minimum Hamming distance.

2. If an input $\bar{u} = (1,0,1,0),$ what's its corresponding codeword $\bar{v}$?

3. Following the previous problem, find all corresponding check sums for (a_0, a_1, a_2, a_3).

4. If a received code sequence $\bar{r} = (10110011)$, what's the output (or codeword) of RM decoder?

HW # 8

1. Form the generator matrix of the RM(1, 4) code. What is the minimum distance of this code ?

2. Determine its parity check sums, and devise a majority–logic decoder for this code.

3. Decode the following received vector
$$\bar{r} = (0011001001110011).$$

HW #8-1

1. In the previous MATLAB program, we encode each Chinese character with an RM encoding.

2. Since the generator matrix in RM encoding is not systematic, therefore some row operations are taken to make it systemic. Please write a program in MATLAB to do so. And what is the connection between both.

3. Please modify the previous MATLAB program such that this systematic generator matrix is employed . Display the info. bits deteriorated from AWGN in a file.

4. What kind of the shortened RM code is used ?

HW #9

1. What is the generator polynomial $g(X)$ of the three-error-correcting of BCH code with length 31, which employed in Example 4 ?

2. Referring to Example 4, please input a new Chinese poem, and what is the result of this poem with BPSK signal transmission over the Rayleigh fading channel as SNR = 6.0 ?.

HW #10

1. In Example 6, what are the error pattern $e(X)$ and the output of BCH decoder, if the received vector is

$$\overline{r} = (0001010000000000)$$

HW #10-1

1. Referring to Example 6, what is the result of this photo with BPSK signal transmission over the Rayleigh fading channel as SNR = 6.0 ? Compare with the results of Example 6.

2. Referring to Example 7, what is the result of this sound record with BPSK signal transmission over the Rayleigh fading channel as SNR = 6.0 ? Compare with the results of Example 7.

3. Referring to Example 3, find the BCH decoded sequence.