CHANNEL CODING

SECTION 5 QUESTION 1 (2 points possible)

Which of the following statement(s) is(are) generally true about channel coding?

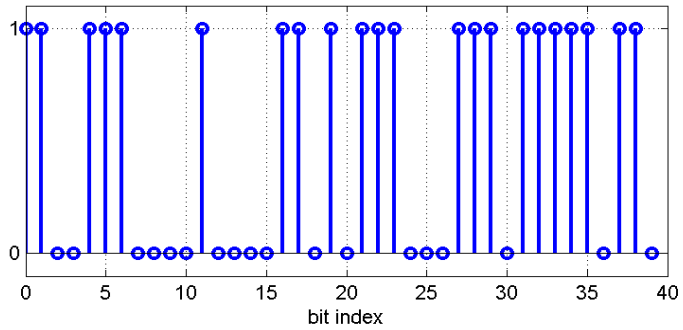
Please select the correct statement(s).

- [x] Channel coding reduces the bit error rate of a communication system. ✔
- [ ] Channel coding reduces bit errors by increasing the signal to noise ratio of the received signal.
- [x] Channel coding relies on redundancy to detect or correct bit errors ✔
- [x] If there are two codewords in an error correcting code that differ by 3 bits, then this error correcting code can always detect errors in two bits per codeword.

Hide Answer *You have used 1 of 1 submissions*

SECTION 5 QUESTION 2 (2/2 points)

Assume that a sequence of eight bits is encoded using a (5,1,5) repetition encoder. Suppose that we receive the following bit sequence at the output of a binary channel that introduces occasional bit errors. Assume bit index 0 corresponds to the start of the received codeword corresponding to the first bit. If at most two bit errors occur within each codeword, what was the transmitted sequence of eight bits?



Please input an eight bit sequence as a sequence of 1's and 0's with no spaces between, e.g. 10101....

10011111

10011111

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SECTION 5 QUESTION2 INTRODUCTION

Consider a **(n, k, 4)** block code, where 6 parity bits **[P1 P2 P3 P4 P5 P6]** are generated for 6 data bits **[D1 D2 D3 D4 D5 D6]**. The values of the parity bits are computed by arranging the data and parity bits in a block as shown below.

D_1	D_2	D_3	P_1
D_4	D_5	D_6	P_2
P_3	P_4	P_5	P_6

The first 5 parity bits are generated to ensure that all rows and columns containing data bits have even parity, and the last parity bit **P6** ensures that the entire code word has even parity. The resulting codeword is **[D1 D2 D3 D4 D5 D6 P1 P2 P3 P4 P5 P6]**.

SECTION 5 QUESTION 3 PART A (2/2 points)

What are the values of n and k for the code above?

Please key in the numerical values on the boxes provided below.

$n = ?$

12

12

$k = ?$

6

6

Show Answer *You have used 1 of 1 submissions*

SECTION 5 QUESTION 3 PART B (2/2 points)

Assume we are interested in only detecting, but not correcting, bit errors. What is the maximum number of bit errors per codeword that can be detected using this coding scheme?

Please key in the numerical value on the box provided below.

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3

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SECTION 5 QUESTION 3 PART C (2/2 points)

Suppose that the received codeword is **[0 1 1 0 0 1 1 1 1 1 0 0]**. Assuming that at most one bit error occurred during transmission, what was the transmitted codeword?

Please input a 12 bit sequence as a sequence of 1's and 0's with no spaces between, e.g. 10101....

111001111100

111001111100

Show Answer *You have used 1 of 1 submissions*

SECTION 5 QUESTION 3 PART D (2 points possible)

Suppose that the received codeword is [0 0 1 0 0 1 1 1 1 1 0 0]. Assume that at most two bit errors have occurred.

Which of the following statements is incorrect?

Please select the correct answer.

- The transmitted codeword could have been [1 1 1 0 0 1 1 1 1 1 0 0].
- The transmitted codeword could have been [0 0 1 1 1 1 1 1 1 1 0 0].
- The transmitted codeword could have been [1 0 1 0 1 1 1 1 1 1 0 0]. ✔
- The transmitted codeword could have been [0 0 1 0 0 1 1 1 0 0 0 0]. ✖

Hide Answer *You have used 1 of 1 submissions*

SECTION 5 MATLAB QUESTION (3/3 points)

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In this MATLAB question, you will implement an encoder for the **(6,3,3)** block code.

The initial code in the code window will generate a 60-bit long random sequence stored in **bs_raw**. Your job is encode **bs_raw** using the (6,3,3) code and store the encoded bitstream as **bs_enc**.

With the (6,3,3) code, the data to be encoded is first divided into blocks of three bits **[D1 D2 D3]**. Each codeword contains the data bits and three parity bits **[P1 P2 P3]**. The values of the parity bits are computed to ensure that all rows of the following table have even parity. Note that the message bits occur twice in this table.

D_1	D_2	P_1
D_2	D_3	P_2
D_3	D_1	P_3

The final codeword is obtained by concatenating the data and parity bits **[D1 D2 D3 P1 P2 P3]**.

In the encoded bitstream, codewords occur one after the other with no interleaving.

```
bs_raw = rand(1,60)>0.5;   % generate random 60 bit sequence
%disp(bs_raw);
% place your code below that
% encodes bitstream bs_raw and store the encoded bit in bs_enc
%bs_enc = bs_raw;
codeword = 1:6;     % codewords are 6 bits each
%codewords= cell(20,1);
add3bits = [3,3,3,0,0,0];
bsencArr = zeros(20,6); %20 code words of 6 bits each
bs_enc = 1:120;
codeIndex = [1,2,3,0,0,0];
encIndex = [1,2,3,4,5,6];
add6bits = [6,6,6,6,6,6];
%disp(bs_enc);
for i=1:20, % loop over all messages
```

Correct

```
bs_enc=[];
for i=1:3:length(bs_raw)
    msgblk = bs_raw(i:i+2);
    P1=xor(msgblk(1), msgblk(2));
    P2=xor(msgblk(2), msgblk(3));
    P3=xor(msgblk(3), msgblk(1));
    codeword = [msgblk P1 P2 P3];
    bs_enc = [bs_enc codeword];
end
```

Hide Answer *You have used 2 of 5 submissions*

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