Serial # 0

- 1 points for not writing your serial number

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE418: Satellite Communications (121)
Quiz 6: Error Control Coding in Satellite Systems
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Name: KEY

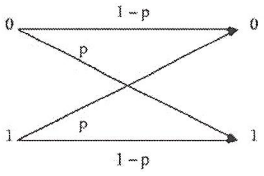
Choose the correct answer:

a) Channel capacity is inversely proportional to channel bandwidth.
b) The minimum E_b/N_0 , at which we can communicate is 0dB.
c) Channel capacity is inversely proportional to signal power.
d) Spectral efficiency is measured in bits/Hz.
(e) There is no way we can have error free communications at $E_b/N_0 = -1.8dB$

A binary symmetric channel (BSC) with cross over probability, p=0.1. If the earth station is transmitting a block of bits 11011 over this channel, what is the probability of receiving 11010 by the satellite?

11011
11010

$(1-p)^4 p = (1-0.1)^4 (0.1) = 0.06561$



For the code shown in the table

Table 11.1 Code Words of a (7, 4) Hamming Code

Message Word	Code Word	Weight of Code Word	Message Word	Code Word	Weight of Code Word
0000	0000000	0	1000	1101000	3
0001	1010001	3	1001	0111001	4
0010	1110010	4	1010	0011010	3
0011	0100011	3	1011	1001011	4
0100	0110100	3	1100	1011100	4
0101	1100101	4	1101	0001101	3
0110	1000110	3	1110	0101110	4
0111	0010111	4	1111	1111111	7

a) **Is this code systematic or no ?**...yes... **Justify your answer**...The 4 bits to the right are data

b) **What is the minimum distance?**
.....3.....

c) **How many errors can this code detect?**.....2..... $d_{min} - 1$

d) **How many errors can this code correct?**.....1.....

e) **If a block size of 7 is used and probability of bit error (crossover) is $p = 10^{-1}$, with the above code for error detection. Find the frequency of retransmission if ARQ is used.**

$P_e = \binom{7}{1} p(1-p)^6 + \binom{7}{2} p^2 (1-p)^5 = 7(0.1)(0.9)^6 + \frac{7\times6}{2}(0.1)^2(0.9)^5 =$

$= 0.372 + 0.124 = 0.496$

Freq. $\frac{2.016}{} = \frac{1}{0.496} \simeq 1$ every 2

If stop-and-wait ARQ system is used what is the throughput (assume round trip delay of 0.48 seconds, and a transmission rate of 2 M bits/sec). Comment on the efficiency of stop and wait system in satellite applications.

Retransmission every 2 Code words $= 2.016 * 7 = 14.112$

$$\frac{14.112 \text{ bits}}{\frac{14.112 \text{ bits}}{2\text{M bits/sec}} + 0.48 \text{ sec}} = \frac{14.112}{7.056\mu + 0.48} = 29.4 \text{ bits/sec}$$

Good Luck, **Dr. Ali Muqaibel**