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06EC65

Sixth Semester B.E. Degree Examination, December 2011
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. The international morse code uses a sequence of dots and dashes to transmit letters of English alphabets. The dash is represented by a current pulse that has a duration of 3 units and the dot has a duration of 1 unit. The probability of occurrence of dash is 1/3 of the probability of occurrence of a dot.
   i) Calculate the information content of a dot and a dash.
   ii) Calculate the average information in the dot dash code.
   iii) Assume that the dot lasts 1 msec which is the same interval as the pause between symbols. Find the average rate of information transmission. **(08 Marks)**

b. For the source model shown in Fig.Q1(b), find the source entropy and the average information content per symbol in messages containing one, two and three symbols.

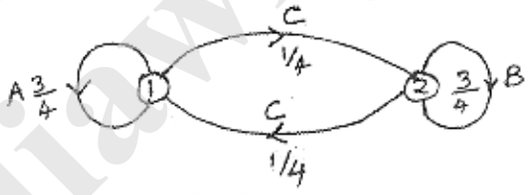
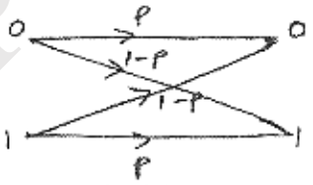


Fig.Q1(b) **(12 Marks)**

2 a. For the binary symmetric channel shown in Fig.Q2(a), find the rate of information transmission over the channel when p = 0.9, 0.8 and 0.6, given that the symbols rate is 1000/sec. **(06 Marks)**



P[x = 0] = 1/2

P[x = 1] = 1/2

Fig.Q2(a)

b. A source emits an independent sequence of symbols A, B, C, D and E with the probabilities 1/4, 1/8, 1/8, 3/16 and 5/16 respectively. Find the Shannon code and efficiency. **(08 Marks)**

c. A binary source emits an independent sequence of 0's and 1's, with probabilities p and 1 – p. Prove that the entropy is maximum at p = ½. Plot the entropy. **(06 Marks)**

3 a. Explain the prefix coding and decision tree with examples. **(08 Marks)**

b. A discrete memoryless source has an alphabet of five symbols, with their probabilities as given below.

Symbol	S_0	S_1	S_2	S_3	S_4
Probability	0.55	0.15	0.15	0.10	0.05

Compute two different Huffman codes for this source. For each of the two codes, find
i) The average code word length ii) The variance of the average code word length over the ensemble of source symbols. **(12 Marks)**

4 a. Derive an equation for the capacity 'C' of a channel of Bandwidth B Hz effected by additive white Gaussian noise of power spectral density of $N_o/2$. **(10 Marks)**

b. An analog signal has a 4 kHz bandwidth and is sampled at 2.5 times the Nyquist rate and each sample is quantized into one of 256 equally likely levels.

i) What is the information rate of the source?

ii) Can the output of this source be transmitted without errors over a Gaussian channel with a Bandwidth of 50 kHz and S/N of 20 db?

iii) What will be the bandwidth requirements of an analog channel for transmitting the output of the source without errors, if the S/N ratio is 10 db? **(10 Marks)**

PART – B

5 a. Write a note on encoding and decoding of linear block code. **(06 Marks)**

b. The parity clock bits of a (8, 4) block code are generated by

$C_5 = d_1 + d_2 + d_4$ $C_6 = d_1 + d_2 + d_3$ $C_7 = d_1 + d_3 + d_4$ $C_8 = d_2 + d_3 + d_4$

where d_1, d_2, d_3 and d_4 are message bits.

i) Find the generator matrix ad parity check matrix.

ii) Find the minimum weight of this code.

iii) Show through an example that this code can detect and correct errors. **(08 Marks)**

c. Design a single error correcting code with a message block size of 8-bits. **(06 Marks)**

6 a. The generator polynomial of a (7, 4) cyclic code is $g(x) = 1 + x + x^3$.

i) Find the codewords for messages 1010, 1110, 1100, 1111.

ii) Find the codewords for i) using the systematic form. **(08 Marks)**

b. Discuss the features of encoder and decoder, used for cyclic codes, with examples. **(12 Marks)**

7 Write short notes on any four:

i) RS codes ii) BCH codes iii) Golay codes

iv) Shortened cyclic codes v) Burst error correcting codes. **(20 Marks)**

8 Consider a (3, 1, 2) convolutional code with

$g^{(1)} = 110$; $g^{(2)} = 101$; $g^{(3)} = 111$

i) Draw the encoder block diagram

ii) Find the generator matrix

iii) Find the codeward corresponding to the information sequence 11101, using the time domain and transform domain approach. **(20 Marks)**

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